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XIX.—*Descriptions of New Pyralidæ of the Subfamily Pyraustinae.* By Sir GEORGE F. HAMPSON, Bart., F.Z.S., &c.

[Continued from vol. i. p. 280.]

(3) *Megastes erythrostolalis*, sp. n.

♀. Head yellow suffused with red; thorax and abdomen pale red with a crimson tinge or sometimes with a red-brown tinge; palpi white at base; pectus, legs, and ventral surface of abdomen silvery white. Fore wing pale red with a crimson tinge, more or less strongly suffused with silvery grey, the costa yellow from before the antemedial line to the postmedial line; antemedial line hardly traceable except at costa, red, oblique to discal fold and with slight yellowish-white spots on its outer side in upper part of cell, below the cell, and above inner margin; a bar-shaped yellowish white spot in end of cell with its lower extremity rather angled inwards and a large lunulate spot below end of cell, both defined by crimson red; postmedial line formed by slight brown lunules tinged with red, oblique to vein 6 and slightly incurved at discal fold, a small yellow spot beyond it above vein 7 and larger white spot above vein 6, then defined on each side by slight yellow marks to vein 2; the terminal area yellow invaginated with red, its inner edge waved; a brown terminal line; cilia yellowish white. Hind wing pale red with a crimson tinge and more or less suffused with leaden grey especially just beyond the postmedial line; a large yellowish white patch beyond the cell before the postmedial line narrowing to a point at vein 1, defined on inner

side by an oblique crimson-red line and with some crimson-red scales on it between veins 5 and 3; postmedial line crimson-red defined on outer side by narrow yellow marks in the interspaces, slightly waved, excurved to vein 3 then incurved and ending at tornus; the terminal area yellow irrorated with red, its inner edge waved; a brown terminal line; cilia yellowish white. Underside silvery white, the terminal half of fore wing and the hind wing except the cell and costal and terminal areas faintly tinged with brown; the fore wing with slight brown discoidal bar, waved postmedial line bent inwards at vein 2 to below end of cell, and wedge-shaped red-brown postmedial patch from costa to vein 5; the hind wing with waved red-brown postmedial line, indistinct except between veins 6 and 5.

*Hab.* VENEZUELA, Esteban Valley, Las Quiguas (*Klages*), 2 ♀ type. *Exp.* 36-38 mm.

(6) *Omphisa leucostalis*, sp. n.

♂. Head and thorax white mixed with some red-brown; abdomen white with red-brown segmental lines except on terminal segments and oblique blackish subdorsal streaks on segments 3 to 5, the anal tuft with some red-brown at base; palpi with black marks on the 1st and 2nd joints at sides and the 3rd joint black; pectus, legs, and ventral surface of abdomen white, the legs tinged with brown. Fore wing white irrorated with a few cupreous-brown scales, especially on basal area; antemedial line cupreous brown, oblique; a minute cupreous brown spot in middle of cell and discoidal bar with white striga on it, a point beyond lower angle of cell above base of vein 3; postmedial line cupreous brown, forming a semicircular mark at costa, slightly angled outwards below costa, then incurved, excurved between veins 5 and 4, then oblique to vein 2 where it is retracted upwards to lower angle of cell, then oblique to inner margin at the antemedial line; subterminal line cupreous brown, slightly angled inwards at vein 6, then obliquely excurved to vein 4, then oblique and sinuous to the sinus of the postmedial line at vein 2 and excurved above inner margin; a slight cupreous brown terminal line. Hind wing white; an oblique dark cupreous brown discoidal bar with an oblique slightly sinuous line from it to above tornus; postmedial line cupreous brown, arising below costa and oblique to tornus, slightly excurved between veins 5 and 4; subterminal line cupreous brown, excurved from vein 6 to 4, then oblique to just beyond the postmedial line at vein 2 where it terminates; a dark cupreous brown terminal line and line near base of cilia.

*Hab.* BR. C. AFRICA, Mt. Mlanje (*Neave*), 1 ♂ type. *Exp.* 34 mm.

(5a) *Evergestis doguini*, n. n.

*Evergestis obliquata*, Dogn. Ann. Soc. Ent. Belg. 1905, p. 75 (nec Grote, 1883).

PERU.

(5b) *Evergestis inglorialis*, sp. n.

♂. Head, thorax, and abdomen reddish brown mixed with grey; antennæ dark brown; palpi, pectus, legs, and ventral surface of abdomen white tinged with brown. Fore wing grey strongly suffused with reddish brown; faint obliquely placed dark subbasal spots in and below the cell; antemedial line indistinct, dark, faintly defined on inner side by whitish, sinuous, oblique to median nervure, then inwardly oblique; a slight dark spot in middle of cell and diffused discoidal patch; postmedial line dark brown defined on outer side by whitish, excurved from below costa, where it is met by an oblique whitish shade from apex, to vein 6, then oblique; a rather triangular patch of dark suffusion on terminal area from below apex to vein 4 with a faint dark subterminal line from it to inner margin; a series of small dark spots before termen in the interspaces and a series of terminal black points on the veins. Hind wing semihyaline whitish tinged with brown, the terminal area rather narrowly suffused with dark brown; a terminal series of black points; cilia with a fine white line at base.

Hab. PERU, El Porvenir, 1 ♂ type, Chanchamayo, La Merced (Watkins), 1 ♂. Exp. 36 mm.

(1a) *Azochia trichotarsalis*, sp. n.

Hind tarsi of male fringed with hair above to extremity.

♂. Head and thorax white faintly tinged with brown, the frons dark brown, the neck and shoulders red-brown; abdomen red-brown with some white at base and a series of slight white dorsal spots, the anal tuft black tinged with grey; palpi dark brown above, white below; pectus, legs, and ventral surface of abdomen white, the fore tibiae tinged with brown and black at extremity, the tarsi ringed with brown. Fore wing white, the costa suffused with bronze-brown, the basal area with some dark brown suffusion; antemedial line black-brown, curved and slightly waved; a small elliptical black-brown spot in upper part of cell towards extremity with white striga in centre; a black-brown discoidal bar with brownish white striga in centre and brown suffusion beyond and below it, defined by the black-brown medial line, which arises below the costa, slightly waved to vein 3, then retracted to below the discoidal bar and angled outwards above vein 1; postmedial line black-brown, waved, ending on termen at vein 1, with small black-brown spots on it below veins 3 and 2; black-brown striae before termen above veins 7, 6 and a line between veins 6 and 4; cilia with a series of small dark brown spots. Hind wing semihyaline white; a faint sinuous brown line from lower angle of cell and a rather diffused black-brown patch at inner margin; postmedial line indistinct, brown, arising at vein 6, excurved from vein 5 to below 3 where it terminates; black-brown striae before termen above and below vein 7 and a line from below vein 6 to above 4; cilia with a series of small black-brown spots at base to vein 2.

*Hab.* VENEZUELA, Esteban Valley, Las Quiguas (*Klages*), 1 ♂ type. *Exp.* 42 mm.

(6) *Azochis cymographalis*, sp. n.

Hind tibiae of male at extremity and 1st joint of tarsi without fringes of hair.

♂. Head and thorax rufous mixed with grey; abdomen rufous mixed with some grey, some white at base and slight dorsal white spots on 2nd and 3rd segments, the anal tuft white tinged with brown; frons and palpi deep rufous, the latter white at base; pectus, legs, and ventral surface of abdomen white, the fore and mid legs rufous above. Fore wing white with a faint rufous tinge, the costa rufous; the base suffused with rufous and with a waved blackish line near base; a slightly curved rufous antemedial line; a rufous spot in upper part of cell near its extremity and rufous discoidal bar angled inwards on median nervure, some pale rufous suffusion beyond it and a waved rufous line from vein 2 below end of cell to inner margin; postmedial line rufous, crenulate, erect to below vein 3, then rather oblique to tornus; a rufous terminal line expanding into a slight spot at discal fold and a line near base of cilia. Hind wing semihyaline white with a faint rufous tinge; postmedial line rufous, arising at vein 7 and waved to vein 2, slightly bent outwards at vein 5, at vein 2 bent inwards and almost obsolete to below end of cell, then fuscous and forming a slight diffused patch at inner margin; a rufous terminal line to vein 2 and slight line near base of cilia.

*Hab.* ECUADOR, R. Pastaza, El Topo (*Palmer*), 1 ♂ type, El Rozario (*Palmer*), 1 ♂. *Exp.* 42-44 mm.

(20 a) *Cocidophora ruficostalis*, sp. n.

Fore wing of male with the retinaculum formed by a fan of scales, but without fan at upper angle of cell or postmedial costal swelling.

♂. Head and thorax yellow suffused with rufous; abdomen yellow tinged with rufous; palpi rufous with some white at base; pectus, legs, and ventral surface of abdomen pale yellow, the fore tibiae with rufous band at extremity. Fore wing yellowish suffused with rufous, the base, costal and terminal areas deeper rufous; an indistinct diffused rufous antemedial line; a brown discoidal stigma; postmedial line rather diffused rufous, obliquely curved to vein 2, then erect. Hind wing pale yellow tinged with rufous; an oblique rather diffused rufous postmedial line from costa to vein 2; a rufous terminal band from apex to vein 2; cilia rufous except towards tornus.

♀. Fore wing clearer yellow except the costal and terminal areas, the postmedial line more curved between veins 5 and 2; hind wing clear yellow except the terminal band, the postmedial line excurved between veins 5 and 2.

*Hab.* BR. C. AFRICA, Mt. Mlanje (*Neave*), 2 ♀; PORT. E. AFRICA, Ruo Valley (*Neave*), 4 ♂, 1 ♀, Mt. Chipirone (*Neave*), 3 ♂, 3 ♀ type. *Exp.* 30-34 mm.

(20b) *Crocidophora megalopygona*, sp. n.

♂. Head, thorax, and abdomen yellowish suffused with rufous; palpi rufous, narrowly white in front to extremity of 2nd joint; pectus, legs, and ventral surface of abdomen white. Fore wing yellowish suffused with rufous, the costal area deeper rufous; an indistinct rather diffused rufous postmedial line, incurved below vein 3; a fine rufous terminal line. Hind wing yellowish white tinged with rufous; an indistinct diffused rufous postmedial line from costa to vein 2; the terminal area rufous to submedian fold; cilia tinged with rufous and with a slight rufous line near base to submedian fold. Underside of fore wing with the fan of scales very large and silvery leaden grey.

♀. Fore wing with dark discoidal striga.

*Hab.* "GERM. E. AFRICA," Dar-es-salaam, 1 ♂; BR. C. AFRICA, Mt. Mlanje (*Neave*), 1 ♀; PORT. E. AFRICA, Mt. Chipirone (*Neave*), 4 ♂, 1 ♀ type. *Exp.* 22-26 mm.

(28a) *Crocidophora ruftiaetalis*, sp. n.

♂. Head and thorax pale rufous; abdomen whitish tinged with rufous; palpi white at base; pectus, legs, and ventral surface of abdomen white. Fore wing pale rufous; an indistinct brownish postmedial line, excurved to vein 3, then retracted to median nervure before end of cell and erect to inner margin; cilia white at tips. Hind wing pale rufous, the cell and inner margin whitish; an indistinct brownish postmedial line from discal to submedian fold; cilia whitish at tips.

*Hab.* FORMOSA, Tainan (*Wileman*), 1 ♂ type. *Exp.* 24 mm.

(18a) *Polygrammodes purpureorufalis*, sp. n.

♀. Head, thorax, and abdomen pale purplish red; palpi white below to near extremity of 2nd joint; pectus and ventral surface of abdomen white, the fore coxae purplish red; (legs wanting). Fore wing pale purplish red; a faint brownish spot in upper part of cell towards extremity and discoidal bar; a faint obliquely curved brownish line beyond the cell with another line beyond it, erect to vein 5, then oblique. Hind wing pale purplish red, the costal area to near apex and the inner margin white.

*Hab.* PERT, Chanchamayo, 1 ♀ type. *Exp.* 52 mm.

(23a) *Polygrammodes junctilinealis*, sp. n.

♀. Head and thorax white suffused with rufous; abdomen white tinged with yellow and with rufous towards extremity,

oblique black subdorsal streaks on 2nd to 5th segments; antennae rufous; sides of frons, the 2nd joint of palpi above towards base, and the 3rd joint black; pectus, legs, and ventral surface of abdomen white, the fore legs tinged with rufous, the tibiae with dark band at extremity, and the tarsi ringed with rufous. Fore wing yellowish white, the basal area, costal area to end of cell, the cell, and the veins of terminal half tinged with rufous; a red-brown streak below basal half of costa and diffused red-brown subbasal line from cell to inner margin; a red-brown spot in cell towards its extremity with elliptical red-brown spot below it in submedian interspace, and a quadrate discoidal patch with yellowish striga in centre; postmedial line strong, red-brown, waved, bent outwards between veins 8 and 7, then incurved, angled outwards at vein 5, then again incurved to vein 2 on which it is retracted to lower angle of cell, then oblique and from inner margin curved upwards to the spot below the cell; subterminal line red-brown, waved, excurved at vein 5, then oblique and joined above inner margin by an oblique bar from the angle of the postmedial line at vein 2, bent inwards on inner margin for a short distance; a red-brown terminal line. Hind wing yellowish white; a black-brown discoidal bar with strong slightly curved line from it to above inner margin; postmedial line strong, dark red brown, rather oblique to vein 6, angled outwards at vein 5, then slightly curved to inner margin near tornus, joined at vein 2 by a waved red-brown subterminal line, excurved at vein 5; a dark red-brown terminal line.

*Hab.* SIERRA LEONE, Kennema (*Mrs. Addison*), 1 ♀; UGANDA, Lake George (*Neave*), 1 ♀ type. *Erp.* 38-50 mm.

(25e) *Polygrammodes flavesceus*, sp. n.

♀. Head, thorax, and abdomen pale yellow tinged with rufous; palpi red-brown, white at base; pectus, legs, and ventral surface of abdomen ochreous white, the fore femora dark brown above and the tibiae with dark band at extremity, the tarsi ringed with brown. Fore wing yellow tinged with rufous, the terminal area more suffused with rufous; a faint curved rufous antemedial line; a faint rufous point in middle of cell and discoidal bar; postmedial line pale rufous, slightly waved to vein 5, then excurved and crenulate to vein 2 on which it is retracted to below end of cell, then sinuous to inner margin; the inner edge of the rufous terminal area dentate; some yellow on termen in the interspaces; cilia white with a pale brown line at base. Hind wing pale yellow; a faint waved rufous line from beyond lower angle of cell to inner margin; postmedial line rufous, waved, arising at vein 6, excurved between veins 5 and 3, then oblique to termen above tornus; a slightly waved rufous subterminal line from costa to vein 2, the veins beyond it streaked with rufous; cilia white with a pale brownish line near base.

*Hab.* PERU, San Domingo (*Ockenden*), 2 ♀ type. *Erp.* 42 mm.

Genus *PACHYZANCLA*, insert

Type.

*Psara*, Snell. Tijds. v. Ent. xviii. p. 239 (1875) ..... *perinatalis*,

which has priority.

(1a) *Psara palpalis*, sp. n.

Palpi of male curved outwards and widely separated to near tips, where they almost meet, fringed with hair above and below.

Head, thorax, and abdomen fuscous brown tinged with grey, the last with white segmental lines; frons and palpi black-brown, the latter fringed with white hair below to middle of 2nd joint; pectus, legs, and ventral surface of abdomen white tinged with red-brown, the fore tibiae with black band at extremity. Fore wing white suffused with fuscous brown, the costal area and terminal area broadly fuscous brown tinged with grey; antemedial line blackish, oblique to median nervure; a small blackish spot in middle of cell and discoidal bar; postmedial line blackish defined on outer side by white, erect to vein 5, then excurved to below vein 3, where it is retracted to below end of cell, then oblique to inner margin; a fine whitish line at base of cilia. Hind wing fuscous brown tinged with grey; an oblique blackish discoidal bar; postmedial line blackish defined on outer side by whitish, bent outwards and slightly waved between veins 5 and 2; a slight blackish terminal line and white line at base of cilia.

*Hab.* CAMEROONS, Ja R., Bitje (*Bates*), 2 ♂, 4 ♀; BA. C. AFRICA, Mt. Manje (*Neave*), 1 ♂ type. *Exp.* 26-32 mm.

(1b) *Psara barbipalpalis*, sp. n.

Palpi of male with the second joint fringed with very long hair in front.

♂. Head and thorax pale glossy grey-brown; abdomen whitish tinged with pale red-brown and with slight dark segmental lines, the extremity tinged with fuscous, the genital tufts white; palpi darker brown, white at base, the hair in front of 2nd joint reddish brown; pectus, legs, and ventral surface of abdomen white, the fore tibiae with black band at extremity. Fore wing pale glossy grey-brown; a rather oblique dark antemedial line; a slight dark discoidal lunule; postmedial line dark, slightly excurved to below vein 3, then retracted to lower angle of cell and erect to inner margin. Hind wing pale glossy grey-brown; an oblique dark discoidal bar; postmedial slight, dark, curved, incurved at vein 2; cilia white with a brown line near base; the underside white faintly tinged with brown.

*Hab.* COLOMBIA, Don Amo (*H. H. Smith*), 1 ♂ type. *Exp.* 22 mm.

(20b) *Psara normalis*, sp. n.

♂. Head, thorax, and abdomen pale grey-brown with a faint reddish tinge, the last with whitish segmental lines; palpi darker



brown, white below to near extremity of 2nd joint; pectus, legs, and ventral surface of abdomen white with a faint red-brown tinge, the fore tibiae brown. Fore wing grey-brown with a faint reddish tinge; antemedial line blackish, oblique to median nervure; a slight blackish spot in middle of cell and elliptical black discoidal spot; postmedial line blackish, erect to discal fold, then excurved to below vein 3 where it is retracted to below end of cell and excurved below submedian fold; a fine whitish line at base of cilia. Hind wing grey-brown with a faint reddish tinge; an oblique black discoidal bar; postmedial line indistinct, dark, rather diffused, excurved from discal fold to below vein 3, then retracted to below end of cell and excurved to inner margin; cilia with a fine white line at base, the tips whitish towards tornus.

*Hab.* ECUADOR, Loja (*Abbé Gaujon*), 1 ♂ type. *Exp.* 36 mm.

(20c) *Psara retrorsalis*, sp. n.

♂. Head, thorax, and abdomen very pale reddish brown, the anal tuft white faintly tinged with red-brown; palpi brown, white in front to extremity of 2nd joint; pectus, legs, and ventral surface of abdomen white. Fore wing white suffused with pale red-brown, the marginal areas pale reddish brown; antemedial line pale brown, oblique; an oblique black discoidal striga; postmedial line pale brown defined on outer side by whitish, excurved from vein 5 to below 3, then retracted to just below angle of cell and slightly excurved above inner margin; cilia white tinged with brown. Hind wing very pale reddish brown; a faint oblique dark discoidal bar; postmedial line pale brown slightly defined on outer side by whitish, excurved and very slightly wavel between veins 5 and 2, then retracted to below angle of cell and oblique to above tornus; cilia white with a pale brown line near base; the underside white with a faint brownish tinge, a blackish discoidal point.

*Hab.* ECUADOR, Zamora (*Abbé Gaujon*), 2 ♂ type; PERU, Carabaya, Huacanayo (*Ockenden*), 1 ♂. *Exp.* 26 mm.

(31) *Psara melanosoma*, sp. n.

♂. Head and thorax orange-yellow; abdomen orange-yellow suffused with blackish brown except the three basal segments dorsally; antennae blackish; frons with white lines at sides; palpi grey-brown, the basal joint and the 2nd joint in front at base white; pectus, legs, and ventral surface of abdomen pale grey-brown. Fore and hind wings uniform orange-yellow, the cilia white tinged with brown.

*Hab.* PERU, Carabaya, Oconeque (*Ockenden*), 2 ♂ type. *Exp.* 26-30 mm.

(6) *Rhetoamia rau-signalis*, sp. n.

♂. Head, thorax, and abdomen white mixed with pale red-brown and slightly irrorated with black, the last with white

segmental lines; antennæ tinged with red-brown; palpi pale reddish brown with some white at base; pectus, legs, and ventral surface of abdomen white mixed with pale reddish brown. Fore wing white mostly suffused with pale reddish brown and irrorated with a few black scales; a diffused band of black scales near base; an antemedial band of black scales, indistinct to submedian fold where it is angled outwards, then more distinctly black; a blackish striga in middle of cell and V-shaped white discoidal mark defined by diffused black; a pale reddish brown medial band, erect to median nervure before the discoidal mark, then very oblique and defined on outer side by a waved blackish line; elongate white marks below end of cell above and below vein 2; a faint dark post-medial line, oblique to vein 6, then erect, waved, and with some black scales on it to tornus, a rather triangular pale red-brown patch on terminal area between veins 7 and 3. Hind wing white; a terminal series of dark points to vein 2, a small black patch below vein 2 with a line from it to tornus; cilia with dark brown mixed towards tornus.

*Hab.* PERU, Carabaya, Oconeque (*Ockendrea*), 1 ♂ type. *Ecp.* 38 mm.

Genus *PHLYCTENODES* will stand as

Type.

*Loxostege*, Hüb. Verz. p. 352 (1827) ... *aruginalis*.

(51 a) *Loxostege obliquicollis*, sp. n.

♂. Head and thorax pale ochreous yellow, the patagia with red-brown patches at base, the dorsum of thorax red-brown; abdomen reddish brown, the basal segment ochreous, rufous behind, the anal tuft ochreous; antennæ brown; palpi with some blackish at tips; pectus, legs, and ventral surface of abdomen ochreous white. Fore wing pale ochreous; the cell and fascia below it to middle reddish brown; three obliquely placed reddish brown antemedial spots from below the cell to inner margin; a very oblique reddish brown post-medial band from below the costa to inner margin, conjoined to spots beyond the cell and below base of vein 2; an oblique sub-terminal series of reddish brown spots in the interspaces; a terminal series of small brown spots. Hind wing white, the costal area broadly and terminal area to submedian fold tinged with red-brown. Underside white, the fore wing and costal area of hind wing tinged with red-brown.

*Hab.* TRANSVAAL, Waterberg Distr. (*Zutrencka*), 1 ♂ type. *Ecp.* 30 mm.

(53 a) *Loxostege aureodiscalis*, sp. n.

♀. Head whitish; thorax rufous mixed with whitish; abdomen black with white segmental bands and some rufous at base; antennæ blackish; sides of frons and palpi black, the latter white in

front to extremity of 2nd joint; pectus, legs, and ventral surface of abdomen white, the fore legs suffused with black-brown, the mid and hind legs with red-brown. Fore wing whitish thickly irrorated with rufous and dark brown, the costal area darker towards base; a dark antemedial shade; a whitish medial band thickly irrorated with rufous from subcostal nervure to inner margin; dark bars before and beyond the discocellulars; a whitish band thickly irrorated with rufous before the postmedial line from costa to below vein 3; postmedial line rather diffused black, slightly incurved at discal fold, below vein 3 retracted to lower angle of cell, then erect; cilia white with dark line at middle, the tips with brown mixed. Hind wing deep orange, the inner margin and terminal area black, the latter very broad at costa with its inner edge oblique to vein 4; a round black discoidal spot; cilia white with a dark line at middle. Underside of fore wing black irrorated with white, the basal inner area and bands orange-yellow; hind wing orange-yellow, the black discoidal spot and terminal band irrorated with white.

*Hab.* W. AUSTRALIA, Yallingup (*R. W. Turner*), 1 ♀ type. *Exp.* 20 mm.

#### Genus *CALLIPHLYCTA*, nov.

*Type, C. metaxantha.*

Proboscis fully developed; palpi slightly fringed with hair above and below, in male with the 2nd joint obliquely upturned; the 3rd porrect and long, in female downcurved and extending about three times length of head; maxillary palpi minute; frons smooth, rounded; antennæ of male ciliated and minutely serrate; hind tibiae with the outer spurs nearly as long as the inner. Fore wing with the apex rounded, the termen evenly curved; vein 3 from just before angle of cell; 4, 5 from angle; 6, 7 shortly stalked; 8, 9 stalked; 10, 11 from cell, 11 anastomosing with 12; the retinaculum of male bar-shaped. Hind wing with the cell long; vein 3 from well before angle of cell; 4, 5 from angle; 6, 7 from upper angle, 7 anastomosing with 8.

In key differs from *Calamochrous* in the fore wing having veins 6, 7 stalked and 11 anastomosing with 12.

#### *Calliphlycta metaxantha*, sp. n.

Head yellow, the frons white, the antennæ brown ringed with white, the palpi white tinged with yellow and slightly irrorated with brown; thorax white, the tegulae with their terminal half black, the patagia black at tips and with black spot behind them; abdomen yellow banded with black; pectus, legs, and ventral surface of abdomen white, the fore legs suffused with dark brown, the mid tibiae with black band at extremity, the abdomen with blackish segmental bands. Fore wing silvery white; the costal area dark cupreous brown to the postmedial band; a black-brown

band near base; a cupreous brown antemedial band with darker edges and line of silvery scales at middle, incurved just below the cell; a cupreous brown postmedial band with darker edges and line of silvery scales at middle, incurved to vein 4, then bent inwards to below end of cell and incurved to inner margin; a cupreous brown subterminal band, arising from apex, its inner edge angled inwards at discal fold and its outer edge dentate to vein 4, confluent with the postmedial band below vein 4, then strongly incurved; cilia with series of black spots to vein 4, then a black line interrupted at submedian fold, the tips with brown mixed. Hind wing yellow with black terminal band to below vein 2; cilia white chequered with black to vein 2, then yellow. Underside of fore wing brown, the innerarea white to near tornus; an oblique white subterminal band from costa to vein 6, the termen with the interspaces indented by white marks; hind wing yellow, the costal area white except towards base, a black-brown subterminal band from below costa to below vein 2, its outer edge slightly waved and with the termen white beyond it.

*Hab.* W. AUSTRALIA, Yallingup (*R. W. Turner*), 1 ♂, 5 ♀ type. *Exp.* 26-28 mm.

(1a) *Liopasia apicenotata*, sp. n.

Head and thorax bright red-brown mixed with some yellowish; abdomen with the two basal segments yellow mixed with fiery red and with sublorsal silvery white spots on basal segment, then grey-brown with dorsal silvery white bar on 3rd segment and the anal segment silvery white, the anal tuft fiery red and yellow; antennae brown ringed with white; palpi red-brown, white at base; pectus, legs, and ventral surface of abdomen white, the fore tibiae with some red-brown at base and a band at extremity. Fore wing red-brown tinged with grey and irrorated with blackish; some white at base of inner margin; antemedial line black, oblique to submedian fold, then incurved and slightly defined on inner side by yellowish; a small annulus in middle of cell and oblique discoidal lunule defined by blackish; postmedial line dark, oblique to the subterminal line at vein 5, then rather inwardly oblique and slightly waved to vein 2 where it is bent inwards and oblique to inner margin, with small yellow spots beyond it above and below vein 7 and from below vein 3 to inner margin and sometimes slight yellow and red-brown marks before it between veins 5 and 3; subterminal line red-brown, waved, with yellowish-white spots beyond it in the interspaces between veins 8 and 5, separated by red streaks on the veins, and a spot beyond it above vein 2; a red-brown line before termen; cilia yellowish white intersected with brown at the veins and with red-brown line through them, wholly brown between veins 5 and 3. Hind wing semihyaline white, the termen suffused with red-brown to vein 2; a terminal series of dark points except towards tornus.

Ab. 1. Head and thorax with more yellow, abdomen deep fiery red from 3rd to 7th and base of 8th segment; fore wing yellow mixed with some fiery red, the costal area rufous to the postmedial line, no yellow and white spots beyond the postmedial and subterminal lines, the postmedial line more crenulate between veins 5 and 2.

*Hab.* TRINIDAD (*Jackson*), 2 ♂, 1 ♀ type; VENEZUELA, Palma Sol, 1 ♂, Esteban Valley, Las Quiguas (*Klages*), 1 ♂, 1 ♀. *Exp.* 22-30 mm.

(1b) *Liopasia leucoperalis*, sp. n.

♂. Head and thorax rufous, the latter with some whitish at extremity of patagia and on dorsum; abdomen with the three basal segments silvery white with dorsal rufous streak and segmental lines, then rufous with dorsal and subdorsal silvery white spots on 3rd segment and some white on terminal segments, the anal segment with dorsal and subdorsal silvery white spots and the anal tuft white and rufous; palpi white at base; pectus, legs, and ventral surface of abdomen white, the fore tibiae with red-brown band at extremity. Fore wing rufous, the costal edge white to end of cell, some white at base of inner margin; antemedial line black, oblique to submedian fold, then incurved and with white patch before it on inner margin; a slight black bar in middle of cell, a small round spot at upper angle of cell and minute spot at lower angle; an indistinct waved red-brown postmedial line, oblique to vein 5 at the subterminal line, then inwardly oblique, with silvery white spots beyond it from costa to vein 5 and from vein 3 to inner margin; a waved red-brown subterminal line with rather quadrate silvery white spots beyond it above and below vein 7 and a triangular spot below vein 6, separated by rufous streaks on the veins, a rather bidentate spot beyond it above vein 2; a rufous terminal line; cilia silvery white intersected by rufous streaks on the veins, wholly rufous between veins 5 and 3. Hind wing semi-hyaline white, the termen suffused with rufous to vein 3; a faint curved rufous postmedial line from costa to vein 2; a rufous terminal line except towards tornus; cilia white, intersected by rufous at the veins to vein 2.

*Hab.* PERU, Chaquinayo (*Watkins*), 1 ♂ type. *Exp.* 32 mm.

(5) *Liopasia incoloralis*, sp. n.

♂. Head, thorax, and abdomen white tinged with ochreous and faintly with rufous, the last with diffused blackish bands on 4th to anal segments, the anal tuft with some blackish at extremity; palpi pale rufous, white towards base; pectus, legs, and ventral surface of abdomen white. Fore wing white suffused with pale olive-ochreous, the costal area white to the postmedial line; an oblique olive-ochreous band from below costa before the postmedial line to middle of inner margin; postmedial line rather diffused

olive-ochreous, oblique to vein 6, then rather inwardly oblique. Hind wing pure silvery white.

*Hab.* Ba. E. AFRICA, N. Kavirondo, Maramas Distr., Ilala (Neave), 7 ♂ type. *Exp.* 28 mm.

(8a) *Anarmodia glaucescens*, sp. n.

♂. Head, thorax, and abdomen pale red-brown with a greyish tinge; palpi white in front to near extremity of 2nd joint; pectus, legs, and ventral surface of abdomen white mixed with some red-brown, the fore and mid tibiae red-brown, the tibiae with blackish band at extremity, the tarsi with red-brown bands. Fore wing red-brown glossed with grey; a minute faint blackish spot in middle of cell and two slight blackish discoidal points; an indistinct curved red-brown postmedial line; cilia silvery white, red-brown at base. Hind wing silvery white; two slight blackish marks in the cell and a slight black discoidal lunule; the median nervure and veins beyond lower angle of cell streaked with red-brown; postmedial line dark brown, curved and slightly waved, ending at submedian fold; the termen suffused with dark reddish brown, narrowing to tornus; the cilia silvery white with a series of small dark spots at base to vein 2; the inner margin fringed with black-brown hair; the underside with short black streak followed by a point in the cell and small black discoidal lunule, the postmedial line dentate to vein 5, then with blackish points in the interspaces, the termen irrorated with dark brown.

*Hab.* ECUADOR, R. Pastaza, El Rosario (Palmer), 3 ♂ type. *Exp.* 50 mm.

(11) *Anarmodia tesselliferentis*, sp. n.

♂. Head and thorax rufous, the latter with some whitish behind; abdomen red-brown mixed with some whitish and with red-brown segmental lines; antennae with the basal joint white in front; frons with white lines at sides; palpi deep rufous, white below to extremity of 2nd joint; pectus, legs, and ventral surface of abdomen white, the fore and mid tibiae rufous, the abdomen irrorated with brown. Fore wing rufous, the costal area tinged with whitish, the medial area with the submedian interspace and the interspaces beyond the cell white tessellated with black spots, the terminal area tinged with grey; antemedial line indistinct, dark, oblique; the terminal part of cell with a white fascia with a black spot on it at middle of cell with some rufous scales in centre; a quadrate grey-brown discoidal spot, defined at sides by black; postmedial line formed by blackish scales, slightly sinuous, oblique to vein 7 and incurved below vein 3; the terminal area with some blackish irroration in the interspaces; cilia silvery white, dark brown at base. Hind wing silvery white; a slight brown streak on median nervure and oblique black discoidal striga; postmedial line dark, very slightly dentate, indistinct to vein 5, then blackish

and ending at vein 2; the termen narrowly red-brown except at apex; cilia white with slight blackish spots at the veins to vein 2. Underside of fore wing white, the costal and terminal areas grey-brown, the spots in the cell black, the postmedial line black and dentate; hind wing with the medial area irrorated with some black scales except towards inner margin, especially above end of cell, the postmedial line produced to minute black streaks on the veins, the termen irrorated with blackish except towards apex.

*Hab.* PERU, Acopampa (*Watkins*), 2 ♂ type. *Exp.* 52 mm.

(1a) *Baotarcha microselene*, sp. n.

♀. Head, thorax, and abdomen dark brown with a cupreous gloss; palpi white at base; pectus, legs, and ventral surface of abdomen silvery white. Fore wing dark brown with a cupreous gloss; a faint dark line from origin of vein 2 to inner margin; a slight white discoidal lunule defined by blackish; cilia whitish at tips. Hind wing dark brown with a greyish gloss; a faint dark postmedial line from costa to vein 2; cilia white at tips and the hair on inner margin white; the underside white, the terminal area tinged with brown, a dark postmedial line from costa to discal fold.

*Hab.* COLOMBIA, Choko Prov., Condoto (*Spurrell*), 1 ♀ type. *Exp.* 22 mm.

(4c) *Baotarcha caeruleincta*, sp. n.

♂. Frons grey-brown with white lines at sides, the vertex of head white mixed with rufous, the antennae dark brown with white points in front towards base and the basal joint white on outer side, the palpi rufous, white above defined below by blackish; thorax pale red-brown glossed with silvery blue; abdomen pale rufous with some white towards extremity; pectus, legs, and ventral surface of abdomen white, the fore and mid femora suffused with rufous, the fore tibiae banded with black, the mid tibiae irrorated with black, the tarsi banded with black. Fore wing semihyaline whitish suffused with red-brown and glossed with silvery blue, the costa and terminal area dark cupreous brown; antemedial line dark brown, oblique; a dark brown discoidal bar; postmedial line brown with minute blackish streaks on the veins, defined on each side by white marks at costa and incurved below vein 3; a white mark on termen at submedian fold; cilia cupreous brown with a fine white line at base to vein 2, then white. Hind wing semihyaline white; a series of black points on termen to vein 3.

*Hab.* DUTCH N. GUINEA, Mt. Goliath (*Meek*), 1 ♂ type, Snow Mts., Oetakwa R. (*Meek*), 1 ♂. *Exp.* 28 mm.

(2a) *Calamochrous fulvitinctalis*, sp. n.

Head and thorax fulvous with a yellowish tinge; abdomen with the three basal segments fulvous, white at sides, the 3rd with a silvery white band behind expanding rather triangularly on dorsum, the 4th with small dorsal silvery white spot, the 4th to anal segments pale red-brown, the anal tuft white tinged with rufous;

palpi white below towards base; pectus, legs, and ventral surface of abdomen silvery white, the fore tibiae with brown band at extremity. Fore wing yellow suffused with fulvous, the costal edge pure white, red-brown towards base; antemedial line fulvous brown, very oblique to median nervure, then erect and with clearer yellow before it; a minute fulvous brown spot in the cell towards extremity and small discoidal lunule; a fulvous brown shade beyond the cell between veins 8 and 3; postmedial line rather diffused fulvous brown, slightly incurved from below costa to vein 5, then excurved and waved to vein 3 where it is retracted to the lower edge of the shade and erect to inner margin; a series of minute fulvous spots before termen. Hind wing pure white with a faint yellowish tinge on terminal area except towards tornus.

*Hab.* ADMIRALTY Is. (*Meek*), 2 ♂, 3 ♀ type; SOLOMON Is., Choiseul I. (*Meek*), 4 ♂. *Exp.* 32-38 mm.

(14d) *Metasia roseociliaris*, sp. n.

♀. Head, thorax, and abdomen white with a faint brownish tinge, the last with the terminal segments tinged with pink; palpi red-brown, white below except at tips; pectus, legs, and ventral surface of abdomen white slightly mixed with brown. Fore wing whitish tinged with pale red-brown, the costa black towards base with some pinkish below it; an indistinct curved red-brown antemedial line; a slight red-brown discoidal striga; postmedial line indistinct, pale red-brown, rather oblique to vein 5, bent outwards between veins 5 and 2, then retracted to below end of cell and slightly excurved to inner margin; a terminal series of slight pale red-brown strigæ; cilia tinged with pink. Hind wing whitish tinged with pale red-brown; a dark brown discoidal bar; postmedial line dark brown, slightly excurved to discal fold, bent outwards between veins 5 and 2, then retracted to below end of cell and oblique to inner margin near tornus; a terminal series of slight brown strigæ; cilia tinged with pink. Underside tinged with pink, the discoidal lunule with white striga in centre, the postmedial line dark brown.

*Hab.* BR. C. AFRICA, Mt. Mlanje (*Neave*), 1 ♀ type. *Exp.* 26 mm.

(1a) *Gonopionea biconicalis*, sp. n.

Head and thorax rufous, the latter with a silvery gloss except on tegulae; abdomen whitish suffused with rufous and with dark brown towards extremity, the genital tufts yellowish white; antennæ ringed with black; sides of frons and maxillary palpi dark red-brown; palpi rufous, white below towards base; pectus, legs, and ventral surface of abdomen silvery white, the fore tibiae with brown band at extremity. Fore wing rufous glossed with silvery blue; a conical yellow antemedial patch from costa to median nervure, its inner edge angled inwards at costa, defined on inner side by the blackish antemedial line which is obliquely excurved to median nervure and incurved just below the cell, defined on outer side by a blackish line except at costa; a conical yellow postmedial



patch from costa to vein 4, defined at sides by sinuous blackish lines, the blackish postmedial line arising from its apex and strongly incurved; the termen with slight yellow spots from below apex to vein 4 and with some yellow towards tornus; cilia yellow, red-brown at apex and between veins 4 and 3. Hind wing white, the terminal area tinged with red-brown to submedian fold.

*Hab.* COLOMBIA, Sierra del Libane (*H. H. Smith*), 3 ♂, 1 ♀ type. *Exp.* 22 mm.

(3a) *Gonopionea flavidalis*, sp. n.

♂. Head, thorax, and abdomen white suffused with pale rufous; palpi rufous, white below towards base; pectus, legs, and ventral surface of abdomen pure white, the fore femora and tibiae brown on inner side, the anal tuft brown below. Fore wing yellow tinged with rufous, the inner half clear yellow to the medial line; antemedial line brown, oblique, from cell to inner margin; a brown medial line from origin of vein 2 to inner margin, angled outwards below submedian fold; a rather lunulate white patch just beyond the cell with clear yellow above it on costa, the yellow on outer side and the white patch except above defined by a dark brown line; a red-brown terminal line; cilia yellowish white, with some dark brown at apex and dark brown between veins 4 and 2. Hind wing white with a dark red-brown terminal line to submedian fold, above which it forms a diffused wedge-shaped patch on vein 2, then a faint red-brown terminal line to tornus; the underside white with postmedial red-brown line between veins 6 and 5.

♀. Hind wing with the red-brown on termen rather diffused.

*Hab.* COLOMBIA, Sierra del Libane (*H. H. Smith*), 1 ♂, 1 ♀ type. *Exp.* 26 mm.

(5) *Gonopionea confederalis*, sp. n.

Head, thorax, and abdomen glossy grey-brown; palpi white at base; proboscis white; pectus, legs, and ventral surface of abdomen pure white, the fore tibiae with black-brown band at extremity. Fore wing glossy grey-brown; antemedial line brown, oblique to submedian fold, then erect; a white bar in upper part of cell towards extremity defined at sides by blackish; a conical yellowish white postmedial patch from costa to vein 5, defined by black and somewhat constricted below costa; a sinuous blackish line from lower angle of cell to inner margin; cilia dark brown, white from below apex to vein 4 and at submedian interspace. Hind wing pale glossy grey-brown, the cilia white at discal fold and towards tornus; the underside white slightly tinged with brown, a brown discoidal bar, the postmedial line brown, excurved to vein 5, then oblique to submedian fold.

*Hab.* COLOMBIA, Don Amo (*H. H. Smith*), 1 ♂ type, Choko, Juntas del R. Tanana and R. San Juan (*Palmer*), 1 ♀. *Exp.* 16 mm.

[To be continued.]

XX.—New Australian Hymenoptera of the Family Evaniidæ in the British Museum. By ROWLAND E. TURNER, F.Z.S., F.E.S.

*Evania sericans*, Westw.

*Evania sericans*, Westw. Trans. Ent. Soc. London, (2) i. p. 215 (1851).

Kieffer places this species in the section of the genus without spines on the hind tibiæ, probably because Westwood makes no mention of such spines; but the spines are really well developed. Though widely spread, the species seems to be uncommon.

*Hab.* Kuranda, Queensland (*Turner*), May 1913; Mackay, Queensland (*Turner*), March 1892; Victoria (*French*); Yallingup, S.W. Australia (*Turner*), December; Kalamunda, S.W. Australia (*Turner*), February 1914.

*Evania perfida*, Westw.

*Evania perfida*, Westw. Trans. Ent. Soc. London, (2) i. p. 216 (1851). ♂.

This is also erroneously placed by Kieffer in the section without spines on the hind tibiæ. Westwood states that his type came from Tasmania, but the specimen marked by him as *perfida* in the British Museum, which is undoubtedly the type, is from S.W. Australia. I have taken it at Yallingup, and it also occurs at Adelaide.

*Pseudosænus cylindricus*, sp. n.

♀. Nigra, gracillima; mandibulis, apice excepto, testaceis; tibiis macula basali, tarsisque antice intermedisque pallide flavo-bummeis; terebra, valvulisque apice pallide flavis; alis hyalinis, iridescentibus, venis fuscis, stigmatibus testaceo.

Long. 9 mm.; terebræ long. 1.5 mm.

♀. Second joint of the flagellum short, distinctly shorter than the first, the third half as long again as the second, the flagellum clothed with very short black hairs. Head very long and narrow, about four times as long as broad; the eyes elongate-ovate, separated from the hind margin of the head by a distance about half as great as their length; the anterior ocellus situated well behind a line joining the summit of the eyes; the hind margin of the head not carinate. Neck as long as the distance between the tegulae and the anterior angle of the mesonotum. Thorax long and narrow, subcylindrical, the mesonotum rounded anteriorly;

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parapsidal furrows very shallow and narrow, almost obsolete; scutum much longer than the scutellum; median segment with a longitudinal groove. Head and thorax opaque, without sculpture, the face below the antennæ finely punctured. Petiole 2-jointed, the basal portion formed by the first sternite very slender throughout, the apical portion fully half as long again as the basal, gradually widened towards the apex; second segment about equal in length to the basal portion of the petiole; tergites 2-5 much longer than broad. Terebra scarcely longer than the basal portion of the petiole, slender. Hind tibiæ strongly swollen; hind metatarsus nearly equal in length to the four apical tarsal joints; tarsal unguis small. Wings small and short, not reaching beyond the apex of the second tergite.

The male has the second and first joints of the flagellum equal, the third as long as the first and second combined.

*Hab.* Kalamunda, S.W. Australia (Turner), February 1914. Three females and one male. Easily distinguished by the long narrow head and thorax and short terebra. Not nearly related to the New Zealand group typical of the genus, but nearer to American species such as *angustatus*, Kieff. The species included in *Pseudofenus* by Kieffer seem to fall into two groups, one, including the type of the genus, approaching *Hyptiogaster*, the other much nearer to *Fenus*. The first group is confined to New Zealand.

*Pseudofenus fluvialis*, sp. n.

♀. Nigra; mandibulis tegulisque testaceis; tibiis macula basali, tibiis anticis apice, tarsis anticis, metatarsisque intermediis posticisque albidis; terebra valvulisque nigris, apice albidis; alis hyalinis, iridescentibus, venis nigris, stigmatibus brunneo; terebra abdomine paullo brevior.

Long. 11 mm.; terebræ long. 6 mm.

♀. First joint of the flagellum very little longer than the second, the two combined distinctly shorter than the third. Head long and narrow; cheeks very short, almost obsolete; head feebly margined posteriorly, narrowed behind the eyes, which are separated from the hind margin of the head by a distance equal to about one-third of their own length. Anterior ocellus situated just in front of the line joining the summits of the eyes. Head and thorax opaque, without sculpture, clypeus finely and closely punctured. Neck as long as the distance between the tegulæ and the front of the mesonotum; parapsidal furrows narrow, but distinct, finely crenulate; mesonotum rounded anteriorly, scutum as

long as the scutellum. Median segment very delicately rugulose, with a low longitudinal carina, hind coxæ finely granulate. Abdomen long and slender, the first tergite twice as long as the second. Hind metatarsus as long as the four apical tarsal joints; tarsal ungues small.

*Hab.* Perth, W. Australia (*Turner*), February. Two females taken on blossom of *Eucalyptus calophylla* in King's Park.

This is much nearer to the Mexican species, *P. angustatus*, Kieff., than to *P. cylindricus*, but differs in the sculpture of the thorax, the shape of the head, and other details. Kieffer gives two species of *Pseudosphenus* as Australian, but *P. unguiculatus*, Westw., is from New Zealand, and *darwinii*, Westw., belongs to *Hyptiogaster*.

*Pseudosphenus isthmalis*, sp. n.

♀. Nigra; mandibulis fuscis; palpis pallidis; tibiis anticis intermedisque supra, metatarsis anticis intermedisque, tarsis anticis articulo secundo, tarsis posticis, basi extrema articuloque apicali nigris, valvulisque terebræ tertio apicali albidis; pleuris sternoque hic illie nigro suffusis, coxis, trochanteribus, femoribusque anticis ferrugineis; tibiis posticis basi infra albo-maculatis; alis hyalinis, leviter suffusis, iridescentibus, stigmato venisque nigris; terebra corpore vix brevior.

Long. 10 mm.; terebræ long. 9 mm.

♀. First joint of the flagellum as broad as long, half as long as the second, third fully as long as the first and second combined. Head long and narrow, feebly margined and rather strongly emarginate on the hind margin; front convex, subcarinate longitudinally in the middle; cheeks almost obsolete. Anterior ocellus almost on a level with the summit of the eyes, which are separated from the hind margin of the head by a distance equal to slightly more than one-third of their own length. Head opaque, finely coriaceous. Neck nearly as long as the distance between the tegula and the front of the mesonotum; thorax opaque, very delicately rugulose, mesonotum with the anterior margin straight, only rounded at the angles, with two short impressed longitudinal lines from near the middle of the anterior margin; parapsidal furrows distinct, crenulated; scutum longer than the scutellum, præscutum much longer than the scutum. Median segment with a distinct longitudinal carina, transversely rugulose. First abdominal segment twice as long as the second. Hind metatarsus as long as the four apical tarsal joints; tarsal ungues small.

*Hab.* Eaglehawk Neck, S.E. Tasmania (Turner), February 1913. One female.

Differs from *fluvialis* in the proportion of the antennal joints, the shape of the head, the sculpture of the thorax and median segment, the length of the terebra, in colour, and other details.

*Fenus autumnalis*, sp. n.

♀. Nigra; mandibulis apice excepto, tegulis, pedibusque anticis intermediisque ferrugineis; tibiis anticis intermediisque supra, tibiis posticis macula basali, tarsis anticis, tarsis intermediis articulis tribus basalibus, tarsisque posticis, basi apiceque exceptis, albis; terebra, petiolo multo brevior, testacea; valvulis apice albidis, incrassatis; alis hyalinis, venis fuscis; stigmatibus pallido, fusco-marginato.

Long. 14 mm.; terebræ long. 2.5 mm.

♀. Head opaque, somewhat elongate, slightly swollen behind the eyes, the hind margin distinctly carinate. Eyes separated from the hind margin of the head by a distance equal to about one-third of their own length; posterior ocelli level with the summit of the eyes, twice as far from each other as from the eyes; cheeks very short, not half as long as the first joint of the flagellum; a longitudinal carina between the antennæ. Second joint of the flagellum more than half as long again as the first, the third joint distinctly longer than the first and second combined. Neck short; pronotum with a very short and small spine at each angle; mesonotum opaque, coriaceous, with two very short longitudinal impressed lines from the anterior margin; scutellum with well-defined marginal carinæ; median segment rather coarsely rugose-reticulate, with a rather indistinct median carina; hind coxæ coriaceous. Hind metatarsus no longer than the four apical tarsal joints combined, the basal third black, the apical half of the fifth tarsal joint also black. Terebra scarcely half as long as the petiole.

*Hab.* Kalamunda, S.W. Australia (Turner), March 1914. Four females.

Closely allied to *valvularis*, Schlett., but differs in the lesser development of the angles of the pronotum, in the sculpture of the median segment, and in the shorter cheeks. *F. fuscimanus*, Kieff., has the terebra distinctly longer, the cheeks longer, and the sculpture of the thorax rather stronger; and *F. valens*, Kieff., is a much larger insect, more robust, with the sculpture of the median segment tending to transverse striæ and the coxæ black.

*Fœnus exilis*, sp. n.

♀. Nigra, minuta; mandibulis tegulisque testaceis; tibiis anticis intermediisque, tibiis posticis basi, tarsis anticis intermediisque, tarsisque posticis subtus pallide brunneis; terebra, petiolo multo brevior, testacea; valvulis apice albidis; alis hyalinis, iridescentibus, venis fuscis, stigmate fusco-ferrugineo.

Long. 7 mm.; terebræ long. 1.5 mm.

♀. Head elongate, opaque, the hind margin very feebly carinate. Eyes separated from the hind margin of the head by a distance equal to half their own length; anterior ocellus situated a little behind a line joining the summit of the eyes; cheeks very short, not as long as the first joint of the flagellum; a low carina running from between the antennæ nearly halfway to the anterior ocellus. First joint of the flagellum scarcely longer than broad, second scarcely half as long again as the first, third distinctly longer than the first and second combined. Neck rather short, angles of the pronotum unarmed; mesonotum opaque, very finely coriaceous, with two short, obscure, longitudinal raised lines from the anterior margin, the curved line separating the præscutum and scutum very shallow and not crenulate. Scutellum without marginal carinæ; median segment irregularly transversely rugulose; hind coxæ very finely coriaceous. Terebra more than half as long as the petiole; hind metatarsus as long as the four apical tarsal joints combined.

*Hab.* Mt. Wellington, Tasmania, 2200 ft. (Turner), January 1913. One female.

This is not nearly allied to the group of *valvularis*, Schlett., having the head slightly narrowed behind the eyes, the scutellum without carinæ, and the groove between the scutum and præscutum narrow and not crenulate.

*Fœnus steindachneri*, Schlett.

*Gasteruption steindachneri*, Schlett. Verh. zool.-bot. Ges. Wien, xxxv. p. 300 (1885). ♀.

*Hab.* Mt. Wellington, Tasmania, 2200 ft. (Turner). March.

*F. leptotrachelus*, Kieff., is very near this, but cannot be the male of this species, having the head much more strongly narrowed behind the eyes.

*Fœnus macrocephalus*, sp. n.

♀. Maxima, nigra; tibiis anticis intermediisque supra, tarsis

anticiis intermediisque apice infuscatis, tarsiisque posticiis, metatarsis tertio basali articuloque quinto exceptis, albidis; terebra, corpore sesqui longiore, testacea, valvulis apice extremo albidis; alis hyalinis.

Long. 30 mm.; terebræ long. 45 mm.

♀. Head opaque, finely coriaceous, massive, slightly swollen behind the eyes, the hind margin rather feebly carinated. Eyes separated from the hind margin of the head by a distance equal to fully half their own length; posterior ocelli in a line with the summit of the eyes, fully half as far again from each other as from the eyes. Cheeks as long as the first joint of the flagellum; a longitudinal carina between the antennæ. Second joint of the flagellum twice as long as the first, third nearly half as long again as the first and second combined. Neck very short; angles of the pronotum unarmed. Thorax opaque, coriaceous, the sides of the præscutum with fine transverse striæ; præscutum nearly twice as long as the scutum, with two short slightly raised lines converging from the anterior margin; the curved line dividing the scutum and præscutum broad and crenulated. Median segment irregularly transversely rugose-striate, with an indistinct median carina; hind coxæ shining, punctured at the base, finely transversely striated at the apex; hind metatarsus about equal in length to the four apical tarsal joints; the fifth joint long, about equal to the second. Pleuræ finely rugose; mesosternum coarsely transversely striated, the sides of the median segment also coarsely striated.

*Hab.* Victoria (ex coll. Turner, received through C. French).

This is the largest species of the genus known to me. The head and thorax, especially on the sides, are clothed with very short white pubescence, as in *F. breviscutum*, Kieff. The radius is bent into a sharp angle at about two-thirds from its base, as in all the group of *breviscutum*.

#### *Fernus calothecus*, Kieff.

*Gasteruption calothecus*, Kieff. Ann. Soc. Ent. France, lxxx. p. 186 (1911). ♀.

Specimens of this species from Yallingup, S.W. Australia, are larger than the type, measuring up to 22 mm., with the terebra 60 mm., but do not seem to differ appreciably in colour or structure. The type is from Queensland; the cotype has been labelled Mexico, evidently by mistake.

*Flenus bicarinatus*, sp. n.

♀. Nigra; mandibulis basi, pedibusque anticis fusco-ferrugineis; tibiis anticis intermediisque supra, tarsis anticis intermediisque apice infuscatis, tarsisque posticis, metatarsi tertio basali articuloque quinto exceptis, albidis; terebra rufo-testacea abdomine paullo longiore, valvulis apice flavidulis et dilatatis.

Long. 22 mm.; terebræ long. 15 mm.

♀. Head not very strongly narrowed behind the eyes, slightly swollen transversely behind the ocelli, opaque and coriaceous, the hind margin distinctly carinated. Eyes separated from the hind margin of the head by a distance equal to nearly half their own length; posterior ocelli in a line with the summit of the eyes, twice as far from each other as from the eyes. Cheeks half as long again as the first joint of the flagellum, a longitudinal carina between the antennæ, the front depressed on each side above the base of the antennæ; second joint of the flagellum twice as long as the first, third more than half as long again as the first and second combined. Neck rather short; angles of the pronotum almost unarmed. Mesonotum irregularly transversely rugose-striate; with two longitudinal carinæ from near the middle of the anterior margin not reaching the middle of the præscutum, the space between the carinæ transversely striated and deeply depressed. Pleuræ rugose; median segment rather coarsely rugose, convex, with a longitudinal carina, the sides of the segment above the hind coxæ with a few coarse striæ. Hind coxæ shining, rather indistinctly transversely striated. Hind metatarsus as long as the four apical tarsal joints combined. Radius sharply bent upwards towards the costa at about two-thirds from the base, as in *breviscutum* and other allied species.

*Hab.* Swan River, Western Australia.

Easily distinguished by the strong carinæ on the mesonotum.

XXI.—A revised Classification of the Otomyinæ, with Descriptions of new Genera and Species. By OLDFIELD THOMAS.

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THE very striking cranial and dental characters found among the different species of what has hitherto been considered the single genus *Otomys*, have long seemed to indicate that some subdivision of the genus would be advisable.



In Mr. Wroughton's admirable monograph of *Otomys*\*, the characters used are almost entirely dental, little attention being paid to the skull. Now, however, taking cranial characters into full consideration, I find that the group appears to be divisible into three genera, as shown below.

Although not easily defined in a key, the general shape of the skull is quite distinctive of the three genera, and is, I consider, the best indication of their relationships. On the other hand, the grooves on the incisors, and the numbers of the molar laminae, used so effectively by Wroughton and Dollman for the sorting of the species, are so plastic, and show so wide a range of variation, that, however useful for specific distinction, they have to be used with great caution when generic divisions are in question.\*

On this account, while distinguishing as full genera the obviously natural groups typified by *O. brantsii* and *O. unisulcatus*, I have thought it better only to consider those represented by *O. anchietae* and *laminatus* as subgenera of *Otomys*, their distinction being almost entirely based on the plastic dental characters. And the same with *Parotomys brantsii* and *littledalei*.

- |  |  |                                   |
|--|--|-----------------------------------|
| A. Nasals not excessively expanded anteriorly. Tendency to grooving of incisors and extra lamination of molars less; lower incisors not or very faintly grooved; $m^1$ with 4 or, at most, 5 laminae.  |  |                                   |
| a. Bullae very large. No special nasal broadening. $M^2$ composed of two complete laminae and a modified posterior portion .....   |  | 1. <i>Parotomys</i> , g. n.       |
| a <sup>1</sup> . Upper incisors grooved .....  |  | 1 a. <i>Parotomys</i> , s. s.     |
| b <sup>1</sup> . Upper incisors smooth .....   |  | 1 b. <i>Liotomys</i> , subg. n.   |
| b. Bullae normal. A slight nasal broadening. $M^2$ composed of three complete laminae and a posterior trefail .....  |  | 2. <i>Myotomys</i> , g. n.        |
| B. Nasals excessively broadened anteriorly, the premaxillae outside them not or scarcely visible from above. Tendency to grooving of incisors and extra lamination of molars at a maximum; lower incisors, as well as upper, deeply grooved; $m^1$ with 6 laminae or more† ..... |  | 3. <i>Otomys</i> .                |
| c. $M^2$ composed of 4 laminae .....   |  | 3 a. <i>Otomys</i> , s. s.        |
| d. $M^2$ with more than 4 laminae.   |  |                                   |
| c <sup>1</sup> . $M^1$ with 6 laminae, $m^1$ with 7 .....  |  | 3 b. <i>Anchotomys</i> , subg. n. |
| d <sup>1</sup> . $M^1$ with 6-7 laminae, $m^1$ with 9-10 .....   |  | 3 c. <i>Lamotomys</i> , subg. n.  |

\* Ann. & Mag. N. H. (7) xviii, p. 204 (1906). See also Dollman's paper on the East African forms, *op. cit.* (8) xv, p. 149 (1915).

† Five in *O. denti*.

1. *PAROTOMYS*\*, gen. nov.

Genotype, *B. brantsii* (*Otomys brantsii*, Smith).

Skull short, high, considerably bowed. Its general shape showing no trace of the characteristic form found in typical *Otomys*. Muzzle narrow, the nasals not particularly broadened anteriorly. Interorbital region not specially contracted, its edges with well-marked thickened beads and postorbital projections. Interparietal nearly as long as broad. Bullae very large; meatus with a strongly projecting thickened collar on its anterior edge prominently visible from above; the meatal greater than the zygomatic breadth of the skull.

*Teeth.* Upper incisors with either one distinct and one indistinct groove (*Parotomys*, s. s.), or with none at all (subgenus *Liutomys*). Lower incisors without any trace of grooves.

Third upper molar with four laminal elements, the posterior ones somewhat modified. Front lower molar also with four, the two anterior partially coalesced.

This genus is most distinct from the other *Otomyinae*, no forms being known at all intermediate in either skull or tooth characters. It may again be subdivided into two, as follows:—

1 a. *PAROTOMYS*, s. s.

Upper incisors with one distinct outer and one indistinct inner groove. Zygomatic plate evenly convex anteriorly. Palatal foramina short. Bullae nearly spherical.

Genotype as above.

1 b. *LIUTOMYS*†, subgen. nov.

Upper incisors quite without grooves, like the lower. Zygomatic plate more or less cut back anteriorly. Palatal foramina of medium length. Bullae more or less oval.

Genotype:—

*Parotomys* (*Liutomys*) *littledalei*, sp. n.

Size and general appearance as in *P. brantsii*. Colour very much as in the typical (Namaqualand) race of that species, though slightly darker, and so verging towards that of *P. b. intecolus*. The back rather darker than "cinnamon-buff," the sides and belly paler buff, the hairs very broadly

\* *pará*, beside + *Otomys*.

† *leios* + *Otomys*.

slaty basally. Hands and feet buffy white. Tail apparently longer than in *brantsii*, though satisfactory measurements are not available; well haired, dark buffy above, paler below, a variable portion of the upper side of the end of the tail brown or blackish, but this is sometimes scarcely perceptible.

Skull and teeth as indicated in the synopsis and subgeneric diagnoses above.

Dimensions of the type:—

Head and body 157 mm.; tail 97; hind foot 26.

Skull: greatest length 37·6; condylo-incisive length 36; zygomatic breadth 20; nasals  $12·8 \times 4·2$ ; interorbital breadth 6; meatal breadth 21·5; palatilar length 17; palatal foramina 7; bullæ  $12·3 \times 8$ ; upper molar series (crowns) 7·2.

*Hab.* Bushmanland. Type from Tuin, Kenhart.

*Type.* Old male. B.M. no. 12.4.25.9. Original number 7. Collected 16th July, 1911, by Maj. H. A. P. Little-dale. Five specimens.

The specimens of this remarkable animal were placed with the collection of *Otomys brantsii* without examination of the skulls, which were cleaned and put away later. Now, however, study of the skulls shows that Major Little-dale's animal is wholly different, and represents a really interesting discovery.

## 2. *MYOTOMYS* \*, gen. nov.

Genotype. *M. unisulcatus* (*Otomys unisulcatus*, Bts.).

Skull with more indication of an approach to that of *Otomys*. But the muzzle is not modified in the peculiar way characteristic of that genus, the nasals being but little broadened anteriorly, so that the premaxillæ are always clearly visible from above outside them. Interorbital region not specially contracted; its edges with distinct beads, which evenly diverge backwards instead of abruptly curving outwards to form postorbital projections, as is the case in *Otomys*. These beads scarcely run any distance on to the parietals. Other skull-characters much as in *Otomys*.

Teeth not very highly specialized. Upper incisors generally with one narrow groove, which is, however, occasionally obsolescent. Lower incisors not or very faintly grooved. Third upper molar not greatly laminated, the usual condition being three complete laminae and a posterior trefoil, which

*μν + Otomys.*

may in some cases represent two laminal elements; the total therefore usually four and never more than five. First lower molar composed of four laminae or their equivalents, as in *Otomys*.

This genus, although clearly worthy of being distinguished as such, shows more relationship to *Otomys* than is the case with *Parotomys*. One species, indeed, *M. turneri*, both has more expanded nasals than is normal and has clearly five laminae in its  $m^1$ ; but even then there is no equality with the specialized condition found in true *Otomys*, and the frontal ridges are quite as in *Parotomys*, not as in *Otomys*.

The following forms belong to this genus:—

*broomi*, Thos.  
*granti*, Thos.  
*sloggetti*, Thos.  
*turneri*, Wrought.  
*unisulcatus*, Bts.

### 3. OTOMYS, F. Cuv.

Genotype. *O. irroratus*, Bts.

Skull highly specialized. Muzzle with an exaggerated expansion of the nasals in their anterior half, where they are bent down laterally, and quite hide the premaxillae from above. Interorbital region contracted, its edges with high ridges, which posteriorly turn abruptly outward to form postorbital processes, and then run backwards across the parietals.

*Teeth*. Incisors much grooved, the upper with one well-defined groove just outside the middle, the lower with one broad and deep outer groove and on the inner side either the faint indication of a second groove, a shallow but distinct groove, or a deep and distinct second groove, all stages between the three being present.

Molars with great tendency to extra lamination, the third upper molar with from six to ten laminae (five in *O. denti* only) and the first lower with from four to seven.

It does not appear possible to separate satisfactorily the species with two grooves on the lower incisors (*typus* and its allies \*) from the ordinary *Otomys* with only one, as the intergradation in the depth and conspicuousness of the grooves is too complete. On the other hand, two species, *anchieta* and *laminatus*, show such differences in the number of the molar laminae that I have thought they should be

\* Representing *Oreimomys*, Trouess.

subgenerically separated, thus making three subgenera, as follows:—

3 a. *OTOMYS*, s. s.

Genotype. *O. irroratus*, Bts.

First lower molar with four laminae; last upper with 5 to 8.

3 b. *ANCHOTOMYS*\*, subgen. nov.

Genotype and only species. *O. anchieta*, Boc.

First lower molar with five laminae; last upper with seven.

3 c. *LAMOTOMYS*†, subgen. nov.

Genotype and only species. *O. laminatus*, Thos. & Schw.

First lower molar with 6–7 laminae; last upper with 9–10.

*Otomys* contains the great mass of the species of the group, and has by far the largest range, extending from the Cape to Abyssinia, while the other two genera are both confined to South Africa.

The following new forms of this genus appear to need description:—

*Otomys irroratus cornosus*, subsp. n.

Size averaging very large, the skull-length of large specimens greater than in any other *Otomys*.

Colour a dark muddy greyish, darker than in *O. i. auratus*, greyer, especially on the sides and rump, than in true *irroratus*.

Skull as in true *irroratus*, but averaging larger. Laminae of *m*<sup>1</sup> always 6 in number.

Dimensions of the type (measured in the flesh):—

Head and body 201 mm.; tail 125; hind foot 32·7; ear 23·5.

Skull: greatest length 46·3; condylo-incisive length 13·5; zygomatic breadth 23·2; nasals 20·5 × 9·2; interorbital breadth 4; upper molar series 9·2.

*Hab.* Kuruman, Bechuanaland. Alt. 4000'.

*Type.* Adult male. B.M. no. 4. 4. 8. 13. Original number 20. Collected 14th February, 1904, by R. B. Woosnam. Seven specimens.

By their great average size and muddy-grey colour these *Otomys* seem distinguishable from the ordinary *O. irroratus*.

\* ἀγχι, near + *Otomys*.

† λαμω, the maw (also voraciousness) + *Otomys*.

although isolated individuals from elsewhere may be nearly as large. The skull of the type even exceeds in length, though not in bulk, that of the large *O. (Anchotomys) anchieta* of Angola.

*Otomys rowleyi*, sp. n.

Like *O. irroratus* superficially, but apparently really a representative in Portuguese S.E. Africa of the 7-laminated forms of the Zambesi and northwards.

General appearance and colour quite as *O. irroratus cupreus*, but the fur shorter and coarser. Ears and tail not very heavily furred.

Skull of medium size, about equalling that of *O. irroratus*. Nasals differing from those of other S. African forms by their even expansion anteriorly, and the absence of a definite angle at the point where the narrow part passes into the broad—this character quite uniform in the one adult and four young specimens before me. All the other S. African forms have a marked angle at the point referred to.

*Teeth.* Third upper molar with seven laminae in every specimen, this number being that characteristic of the Zambesi and more northward *Otomys*, only rarely and exceptionally occurring in *O. irroratus*.

Dimensions of the type (measured in the flesh):—

Head and body 167 mm.; tail 92; hind foot 27; ear 20.

Skull: greatest length 40; condylo-incisive length 37.7; zygomatic breadth 19.7; nasals 18×7.4; upper molar series 9:1.

*Hab.* Coguno, Inhambane, Portuguese S.E. Africa.

*Type.* Adult female. B.M. no. 6.11.8.77. Original number 1585. Collected 31st July, 1906, by C. H. B. Grant. Presented by Mr. C. D. Rudd.

Accidentally overlooking the fact that one of the series was fully adult, Mr. Wroughton and I provisionally referred this animal in 1906 to *O. irroratus cupreus*, but I now consider that its constant possession of seven laminae in *m*<sup>1</sup> indicates that it is a southern representative in the low hot coast-lands of the more northern forms characterised by that number of laminae, while only six is usual in *irroratus*. The absence of an angular corner halfway along the lateral nasal sutures is also a character which affines it to some of the more northern forms and distinguishes it from *O. irroratus*.

It is named in honour of Mr. F. R. Rowley, Curator of the Royal Albert Memorial Museum at Exeter, to whom both officially and privately the Mammal Department of the National Museum is greatly indebted for assistance.

*Otomys mashona*, sp. n.

Most nearly allied to *O. angoniensis*, but greyer and with differently shaped nasals.

Size about as in *angoniensis* or a little smaller. Fur decidedly finer and softer than in that species. General colour very much as in *O. irroratus auratus* or a shade darker, greyer and less brownish than in *angoniensis*; sides and hips distinctly greyer.

Skull with the nasals shorter and proportionately broader than in *angoniensis*, the broad anterior part shorter and the posterior part more rapidly narrowing backwards; lateral sutures without a marked angle, this character distinguishing the species from *irroratus*.

Third upper molar normally with seven laminae.

Dimensions of the type (measured in the flesh):—

Head and body 171 mm.; tail 108; hind feet 30.

Skull: greatest length 41; condylo-incisive length 39; zygomatic breadth 20.3; nasals  $17 \times 8.9$ ; interorbital breadth 4.3; height from supraorbital edge to alveolus of  $m^3$  13.7; palatilar length 19; upper molar series 9.2.

*Hab.* Mazoe, Mashonaland, Southern Rhodesia. Alt. 4000'.

*Type.* Adult male. B.M. no. 95. 11. 3. 13. Original number 44 B. Collected 5th August, 1895, and presented by J. Ffolliott Darling.

This *Otomys* was identified by Mr. Wroughton with *O. irroratus auratus* of Vredefort Road, Orange River Colony, a locality very much farther south, but I venture to think it is more related to *angoniensis* and *rowleyi*, with which it agrees in the number of its molar laminae and its non-angular nasal sutures.

*Otomys burtoni*, sp. n.

A small species, isolated in the Cameroons.

Size comparatively small. Fur very long and soft, woolly hairs of back about 20 mm. in length. General colour dull grizzled brown with a slight coppery tint, very much as in *O. irroratus cupreus*. Hands and feet dark brown.

Skull not strongly bowed, with rather short muzzle. Nasals of medium broadening anteriorly, the lateral sutures not strongly angular. Interorbital region not heavily ridged.

Upper incisors more pointed backwards than is usual even in this opisthodont genus, the angle ( $50^\circ$ ) lower than in any

other rodent I have measured; their face with the usual deep outer and obsolescent inner groove. Lower incisors with one broad and partially doubled external groove and the usual obsolescent inner one.

Dimensions of the type (measured on the dry skin):—

Head and body 158 mm.; tail 75; hind foot 26; ear 20.

Skull: tip of nasals to back of frontals 27.5; zygomatic breadth 18.5; nasals  $16.5 \times 7.5$ ; interorbital breadth 4.1; breadth of brain-case 14.5; height of supraorbital edge from alveolus of  $m^2$  11.6; palatilar length 16.3; diastema 8.5; upper molar series 8.2.

*Hab.* Cameroons Mountains. Alt. 7000'.

*Type.* Old female. B.M. no. 7.1.1.196. Collected by "Capt. Burton, H.M. Consul of Fernando Po," later Sir Richard Burton. Received with the collection of Mr. R. F. Toms.

This Cameroons *Otomys*, widely isolated as it is geographically from all other members of the genus, seems to be most nearly allied to certain of the Central African species, among which, by Dollman's synopsis, it comes closest to *O. tropicalis nubilus* of the Mount Kenya region. It is, however, conspicuously smaller than that animal, nor can I find any other to which it could be assigned.

I have named it in honour of its famous collector, Sir Richard Burton, to whose ability and energies as a naturalist too little credit has been generally given.

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XXII.—*The Hedgehog of Palestine and Asia Minor.*  
By OLDFIELD THOMAS.

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WHEN writing his paper on the subspecies of *Erinaceus europæus*\* Barrett Hamilton referred five specimens in the British Museum from Mount Lebanon to *Erinaceus concolor*, Martin, described from Trebizond. The type of the latter being wholly black it seemed abnormal, and on this account Barrett Hamilton could not distinguish the Mt. Lebanon specimens from it.

Since that date, however, further knowledge and further material bearing on the question of *E. concolor* has accrued. Miller has shown the definite distinction of *E. roumanicus*

\* Ann. & Mag. N. H. (7) v. p. 360 (1900).



and the forms related to it from *E. europæus* and its allies. This distinction rests mainly in the greater extension in the former of the maxillary bones, which reach further back, so as to coincide almost exactly with the muscular fossa\* of this region. In *europæus*, on the other hand, the fronto-maxillary suture traverses the fossa a marked distance in front of its hinder limit.

Examination of the typical skull of *E. concolor* now shows that its structure is as in *E. europæus*, not as in *E. roumanicus*, and it therefore agrees with certain other forms of this character which Satunin has shown to occur in Transcaucasia, so that it cannot be looked upon in any way as abnormal. Moreover, the same author has described a dark "*E. ponticus*" and a black "*E. ponticus abasgicus*" from the eastern shores of the Black Sea, which would show that a naturally black hedgehog does occur in this region. Probably Satunin's animals are, one or both, referable to *E. concolor*.

This being the case, it is evident that the Palestine and Asia Minor hedgehog, which belongs to the *roumanicus* type, only needs comparison with the last-named species, of which it may be considered a subspecies, as follows:—

*Erinaceus roumanicus sacer*, subsp. n.

General colour brown, about as in *E. europæus*, the head not blackened. Spines with one subterminal dark band. Fur of face, chest, and fore-limbs with a considerable mixture of white hairs, that of the sides and belly uniformly brown.

Skull, on the whole, like that of *roumanicus*, but distinguished by the much greater length and development of the lacrymal crests, which in that animal are reduced to a mere projecting knob above the lacrymal foramen, but in the new form are as long as in *E. europæus*, running back quite to the hinder corner of the muscular fossa above referred to, and being traceable further back still as a ridge across the frontals. Transverse occipital crest relatively higher, projecting above the level of the brain-case.

Dimensions of type:—

Hind foot (c.) 39 mm.

Skull: condylo-basal length 60; zygomatic breadth 37.5; nasals 19.5 × 4; premaxillo-nasal suture 11; maxillo-nasal suture 2.5; distance from posterior end of premaxilla to upper hinder corner of maxillæ 11.5; interorbital breadth 17;

\* Apparently, judging from Dobson, that of the upper half of the *levator labii superioris proprius*.

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intertemporal breadth 14·7; palatal length 33·3; upper tooth-row 31.

*Hab.* Palestine and Asia Minor. Type from near Jerusalem.

*Type.* Adult female with worn teeth. B.M. no. 18. 8. 1. 2. Collected May 1918 during the British campaign, and presented by Capt. Guy C. Shortridge.

Of this hedgehog the Museum contains five specimens, with imperfect skulls, from Mt. Lebanon, presented by Saleem Baroodi, a fine old female from Tortoum near Erzeroum, collected by R. B. Woosnam, and another from Kara Daglı near Konia, presented by L. Ramsay, in addition to the present specimen (the type). I have thought it wise to select as type a specimen from the farthest southern known extension of the group—that is, of the restricted genus *Erinaceus*,—the hedgehogs from further south and east being referable to *Hemiechinus*.

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XXIII.—*On a new Jumping Mite of the Genus Nanorchestes from the Mendip Hills.* By STANLEY HIRST.

THE mite dealt with in the present note is of interest, owing to the fact that the only species of the genus hitherto described (viz. *Nanorchestes amphibius*, Topsent & Trouessart) lives on the sea-shore, between the tide limits or slightly above them. This littoral species was discovered by M. Topsent at Luc-sur-Mer (Calvados), France, and afterwards found by the author at St. Catherine's Point, Isle of Wight. The new species described below has a very different habitat, for it lives on the summit of the Mendip Hills at an altitude of over 800 feet and more than eight miles from the sea-coast.

*Nanorchestes collinus*, sp. n.

General appearance very like *N. amphibius*, Tops. & Trouess., but smaller in size. Hairs on dorsal surface of cephalothorax also very similar. The curious unpaired median structure between the chelicerae is present and strongly curved. This new species differs from *N. amphibius* in the following details of structure:—Dorsal hair on chelicera slender and dividing close to the base into two plumose branches, the outer one being considerably longer than the

other (whereas in *N. amphibius* the dorsal hair is rather stout, stiff, rod-like, and not divided). Hairs on abdomen very similar to those of *N. amphibius*, being short and branched in the same way, but they are finer. The sac-like structure placed immediately behind the eye is almost circular (instead of being rather elongate-oval).

*Length* (slightly pressed by accident) 240  $\mu$ .

*Material.* A single specimen collected by the author on the summit of the Mendip Hills, near Axbridge, Somerset, July 1918.

XXIV.—*On some External Characters of Ruminant Artiodactyla*.—Part III. *The Bubalinae and Oryinae*. By R. I. Pocock, F.R.S.

PARTS I. and II. of this series, supplementing my paper published in the Proc. Zool. Soc. for 1910, appeared in the Ann. & Mag. Nat. Hist. for June and August of this year. As in those papers, the reference numbers inserted after the genera and species in the following pages apply to the treatise issued in 1910.

Subfamily *BUBALINÆ*.

Genus *DAMALISCUS*, Sch. & Thos.

In 1910 I described the preorbital and pedal glands of this genus from dried skins of *D. korrigum*. I am now able to supplement that account from fresh material of two South African species, *D. albifrons* and *D. pygargus*.

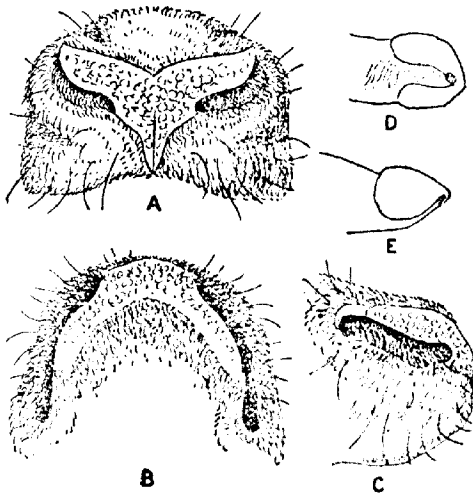
*Damaliscus albifrons*, Burch.

The muzzle (fig. 1, A, B, C) is long, broad, and depressed, with mobile upper lip and fleshy, valvular, narrow, and elongate nostrils, lined for some distance inside, both above and below, with hair. The *rhinarium* is much reduced, but is broad between the narrowed inner ends of the nostrils; beneath the septum it is continued down the upper lip as a short mesially grooved philtrum, which rapidly narrows from its wide base to its pointed lower end which reaches the inferior edge of the upper lip. Dorsally it extends as a moist band along the upper lid of the nostril, but falls short of the posterior angle of the nostril by some distance; on the lower lid of the nostril there is no rhinial extension

of moist skin. From the dorsal aspect the rhinarium appears as a crescentic band, thicker mesially in front than posteriorly at the sides, the hairs on the upper side of the muzzle spreading far forwards between the nostrils, forming a well-defined field with an evenly convex antero-lateral edge. The surface of the rhinarium is covered with a reticulation of grooves defining low rounded eminences.

The preorbital gland is marked externally by a slightly

Fig. 1.



- A. Muzzle and rhinarium of *Danaliscus albifrons* from the front.  $\times 4$ .  
 B. The same from above.  
 C. The same from the side.  
 D. Extremity of the penis of *D. pygmaeus* from below.  
 E. The same from the right side.

raised circular naked area, with a central orifice leading into a short cylindrical tube penetrating about halfway into the substance of the thick gland.

Inguinal glands are absent, and there is a single pair of mammae.

The pedal glands, like those of other Bubalines I have already described, are well developed only on the fore feet, where they consist of a deep and long interdigital pouch overlapped to a great extent above by the folded integument.

of the pastern, but with a comparatively long slit-like orifice. On the hind foot the gland is represented merely by a shallow naked depression.

*Damaliscus pygargus*, Pall.

Differs in none of the particulars described above from *D. albifrons*, except that the philtrum fails to reach the edge of the upper lip.

In the male the *penis* (fig. 1, D, E) ends in a well-defined cordate thickening, broad at the base, narrowed at the apex. The urethral canal is not produced beyond the extremity of the glans, but terminates in a groove in the middle of its under side.

The figure of the penis of *D. albifrons*, published by Garrod (P. Z. S. 1877, p. 11, fig. 22), and apparently copied by Gerhardt, represents this organ as apically attenuated and provided with a short tubular urethral process lying along the left side of the end of the glans and free from it to a very limited extent, but not projecting beyond it.

It seems to me to be very unlikely that two species so closely allied as *D. albifrons* and *D. pygargus* differ in reality in the structure of the penis to the extent indicated by Garrod's observations and my own; and since Garrod's figure shows close agreement between the penis of *D. albifrons* and that of *Connochates*, I am disposed to think it likely that the penis of *D. pygargus* I examined must have been abnormal or, perhaps, mutilated with respect to the end of the urethra.

There the matter must rest until the opportunity of examining this organ in other examples of *D. pygargus* occurs. Considering the rarity of the species we may have to wait long for such a chance to verify or disprove the point at issue.

Genus *CONNOCHEATES*, Licht.

*Connochates gnou*, Zimm. (p. 904).

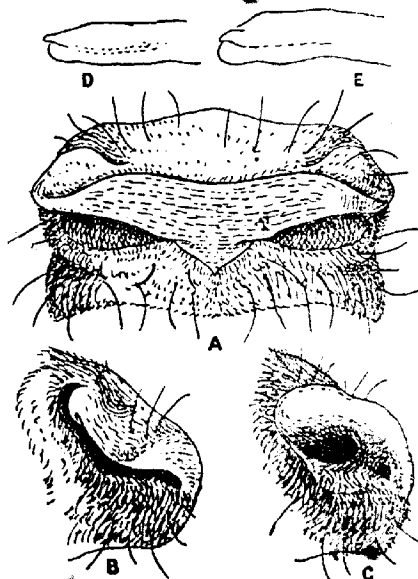
I have very little to add to my original account of this species except some facts regarding the rhinarium and penis which were not described in 1910\*.

The muzzle (fig. 2, A, B, C) is a gross exaggeration of the type seen in *Damaliscus*, being wider and having the valvular lids of the nostrils more protuberant and fleshy.

\* In one specimen the surface of the preorbital gland showed a central cancer-like depression. Hence this surface is not always flat, as described in 1910.

A further important and very interesting difference is the presence of a well-developed pouch, lined with short hair, penetrating the internarial septum on each side and opening by a circular orifice within the anterior angle of the nostril, nearly midway between the latter and the anterior end of entrance to the narial passages. The orifice of this pouch,

Fig. 2.



- A. Muzzle and rhinarium of *Connocetes gnou* from the front.  $\times \frac{1}{2}$ .  
 (The vibrissae shorter than in nature.)  
 B. The same from the side.  
 C. The same with the upper lid of the nostril raised to show the orifice  
 of the sack penetrating the septum.  
 D. Extremity of penis of the same from below.  
 E. The same of *Gorgon taurinus* from the left side.

like the entrance to the chamber itself, is revealed when the upper lid of the nostril is raised and concealed when it is in its normal depressed position (fig. 2, B, C).

Owing to the scanty clothing of hair on the dorsal side of the muzzle, the *rhinarium* is not so well defined above and behind as in *Damaliscus*; it extends less than halfway

round the upper lid of the nostril. Viewed from the front it is exceedingly wide and laterally attenuated, with a concavo-convex, sinuous upper edge. The philtrum, which is broad, angular, and ungrooved, is inferiorly abbreviated, ending in a point a little above the middle of the upper lip, the lower portion of which is continuously hairy across the middle line. The surface of the rhinarium is transversely striated, not roughened and tessellated.

In his paper on the anatomy of the Gnu, Lönnerberg (K. Vet.-Akad. Handl. xxxv. no. 8, p. 48, 1901) paid no special attention to the rhinarium, contenting himself with a reference to the descriptions published by others, notably by Selater and Thomas in the 'Book of Antelopes,' vol. i. This brief description, however, contains no mention of the pouches in the internarial septum, because they are completely concealed in dried skins. No doubt this fact accounts for their having hitherto apparently escaped detection. At all events I have not come across any record of their occurrence.

I am unable to suggest any explanation of the function of these pouches, unless they act as traps for the maggots of parasitic dipterous insects (*Estrus*) whose usual habit it is to pass up the true nostril into the narial passages, where they frequently set up serious disorders in Ruminants. At all events, these parasites would be innocuous in the pouches.

The penis (fig. 2, D) differs from that of *Damaliscus pygargus* in being apically attenuated, without trace of the cordate thickening at the end, and in the termination of the urethral canal in a short process on the left side of the apex, beyond which it projects for a very short distance.

#### Genus GORGON, Gray.

##### *Gorgon taurinus*, Burch. (p. 906).

An example of *G. taurinus albojubatus*, four and a half months old, had the muzzle constructed as in *Connochates gnou*, except that the peculiarities were less exaggerated; it was less depressed and narrower and the rhinarium seen from the front was deeper from above downwards and the shortened philtrum showed a narrow groove.

The preorbital gland was scantily clothed with long hair and its surface was mesially depressed and saucer-like.

The penis (fig. 2, E) of an adult male of the typical race was less attenuated apically than in that of *Connochates gnou* and the urethral canal was not prolonged beyond the end of the glans.

From evidence supplied mainly by the digestive tract,

Lönnberg (K. Vet.-Akad. Handl. xxxv. no. 3 (1901); Arkiv. Zool. v. no. 10, p. 21 (1909)) was of opinion that the Gnus are phylogenetically related to the Bovinae, the latter being the descendants of antelopes closely akin to *Connochates* and *Gorgon*. It appears to me, however, to be certain that the Gnus must be regarded as highly specialised forms of *Bubalis*; but I cannot admit that the latter are in any way nearly affiliated to any form of Bubalinae. The evidence, on the other hand, that the Bovinae are specialised Tragelaphinae is, in my opinion, complete.

The usually recorded differences between the Gnus and Hartebeests in cranial and cornual characters are well known. Using the muzzle as a basis the two groups may be distinguished as follows:—

- |   |                             |
|---|-----------------------------|
| a. Muzzle comparatively narrow; rhinarium cleaving the upper lip approximately to its inferior edge, its depth about half its width, its surface roughened and reticulated; no pouches in the internarial septum within the nostril .....         | <i>Bubalis, Damaliscus.</i> |
| a'. Muzzle comparatively very broad; rhinarium not extending to inferior edge of upper lip, its depth less than half its width, its surface transversely striated; a pair of pouches penetrating the internarial septum within the nostrils ..... | <i>Connochates, Gorgon</i>  |

The Bubalinae constitute a compact group of Bovidae, showing comparatively slight range of variation so far as the external features dealt with in this paper are concerned. The muzzle is expanded, the rhinarium is reduced, the nostrils are valvular and lined within the orifice with longish hair for the exclusion of foreign bodies. The preorbital gland is large and is either provided with a narrow duct-like invagination (*Damaliscus, Bubalis*) or has a flat, slightly convex or slightly concave surface (*Connochates, Gorgon*). Inguinal glands are absent, and there is normally, at all events, a single pair of mammae. Pedal glands are well developed only on the fore feet, where they consist of a long deep interdigital pouch with a long orifice, but not so long as in the Antilopinae, on the front of the pastern. In the hind feet this gland is aborted and represented merely by a shallow depression. The penis at most has a short tubular urethral prolongation.

#### Subfamily ORYXINÆ.

##### Genus ORYX, Blainville.

My account of the cutaneous glands of this genus published in 1910 was based upon an examination of dried skins

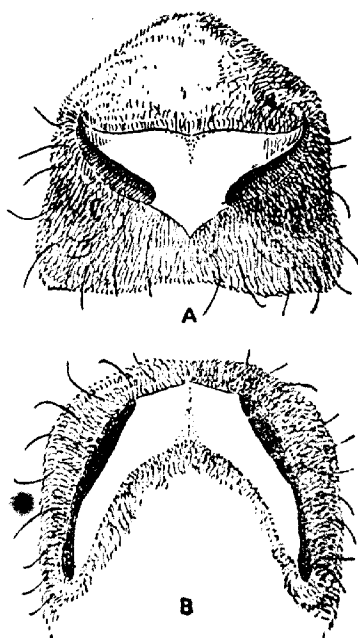


and living animals only. Since that date I have had the opportunity of seeing fresh carcasses of two very distinct species, namely *O. gazella*, the type of the genus, and *O. leucoryx*, which should rank, I think, as a distinct genus

*Oryx gazella*, Linn.

The muzzle (fig. 3, A, B, and 4, F) is broad and depressed,

Fig. 3.



A. Muzzle of rhinarium of *Oryx gazella* from the front.  $\times \frac{1}{2}$ .  
B. The same from above.

with the nostrils narrow, elongated, valvular, and hairy right up to their lower rim. The smooth rhinarium is reduced in size, moderately broad between the nostrils, and extending laterally as a comparatively narrow strip all along the upper rim of the nostrils. From the dorsal aspect it is crescentic, the hairs of the dorsal side of the face extending

far forwards between the nostrils, more than halfway along their length, forming a field with an evenly convex antero-lateral border. From the front the upper edge has a sinuous curvature, and the depth of the rhinarium down the middle line is about equal to the width of the internarial septum; the inferior edge is slightly angled, but is not continued as a philtrum down the upper lip, which is continuously hairy across the middle line\*.

*Preorbital* and *inguinal glands* are absent, as Owen and Ogilby correctly recorded.

The *pedal glands* on all four feet consist of dilated hair-lined pouches, opening by a narrow passage and a small orifice on the front of the pastern just above the summit of the folded interungual web. They resemble those of *O. beisa* described in 1910, except that the orifice is small and sub-circular (cf. *infra*).

*Oryx beisa*, Rupp. (p. 907).

I am indebted to the late Mr. F. C. Selous for the fore and hind foot of an adult example of this species from British East Africa. In these the glands were moderately large and saccular, with a narrow cylindrical exit passage and circular orifice. In 1910 I described the orifice of the gland observed on the dried feet of an immature specimen as consisting of an elongated slit. The shape assumed by the orifice in this case was probably due to shrinkage of the skin when drying. At all events, the glands of the specimen brought for me by Mr. Selous resembled those of the fresh specimen of *O. gazella* described above.

Genus *ÆGORYX*, nov.

Differs from *Oryx* in possessing a preorbital gland, a more reduced rhinarium, and curved horns.

Type, *Ægoryx algazel*, Oken.

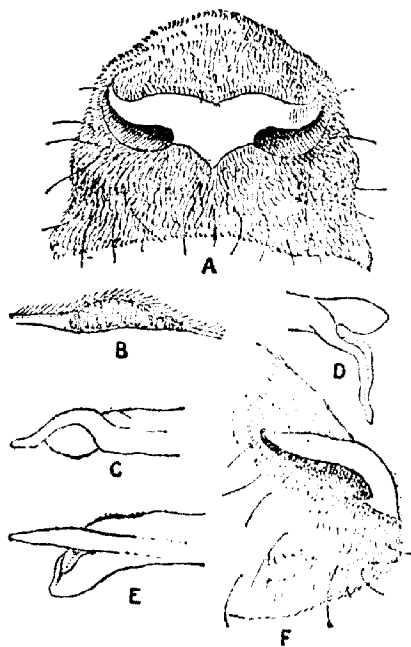
*Ægoryx algazel*, Oken (p. 909).

In 1910 my notes on this species were restricted to the statement that an example living in the Gardens showed the presence of preorbital glands by patches of secretion on the face about one inch in front of the eye, thus disproving the assertions of Owen and Ogilby that the preorbital gland is absent.

\* In the figures illustrating the muzzle of the antelopes described in this paper, no attempt has been made to indicate by shading the transverse and vertical convexity of the rhinarium, which thus appear to be too flat.

In an example of the typical race of this species from Northern Nigeria, the gland (fig. 4, B) consists of a thickened area of skin concealed and overgrown by hair basally adherent with secretion. The gland is about 30 mm. long and 6 mm. thick and slightly elevated, resembling the

Fig. 4.



- A. Muzzle and rhinarium of *Egorge abazel* from the front.  $\times \frac{1}{2}$ .  
 B. Preorbital gland of the same in longitudinal section.  
 C. Extremity of the penis of the same from the left side.  
 D. The same from the right side with urethral process pulled down.  
 E. Extremity of penis of *Hippotragus niger* with urethral process straightened.  
 F. Muzzle and rhinarium of *Oryx gazella* from the side.

corresponding gland of *Hippotragus*, although shorter as compared with its thickness.

The muzzle (fig. 4, A) in its general features is like that of *Oryx gazella*, but the rhinarium is considerably more reduced. When viewed from the front it is much wider as

compared with its height, the height in the middle line being slightly less than that of the upper lip and much less than the width of the internarial septum.

As in other members of this subfamily the *inguinal glands* are absent, there are two pairs of *mamme*, and the *pedal glands* are present and constructed as in *Oryx*.

The *penis* (fig. 4, C, D) is remarkable for the thickness and length of the tubular prolongation of the urethral canal, which projects some distance beyond the ovate termination of the glans and is nowhere adherent to it. It rises from the underside of the cylindrical portion of the penis, and, although normally closely applied to the left side of the well-defined terminal portion, is in reality separable from it. It is thick at the base and gradually attenuated apically.

The penis closely resembles that of *Addax* as described and figured by Garrod (P. Z. S. 1877, p. 10, fig. 18); but Gerhardt's figure of the penis in *Addax* has a much shorter urethral prolongation, not overlapping the tip of the glans (Verh. Deutsch. Zool. Ges. xvi. p. 153, 1906).

#### Genus HIPPOTRAGUS, Sund.

##### *Hippotragus niger*, Ham. (p. 909).

Specimens examined since 1910 confirm in every particular the facts stated in that year as to the structure and incidence of the cutaneous glands. The new facts here recorded relate to the rhinarium and the penis.

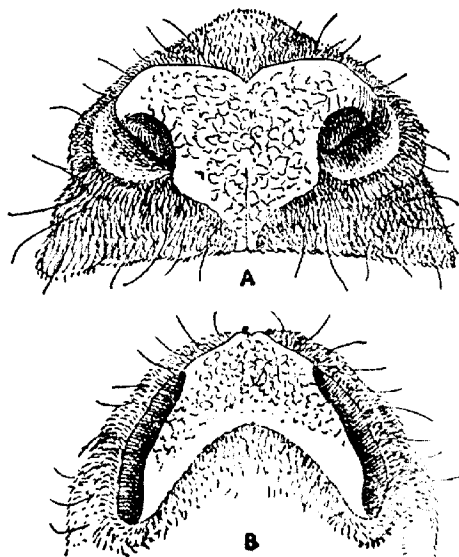
The muzzle (fig. 5, A, B) is less depressed than that of *Oryx*, and the sculptured rhinarium is relatively larger and more normal, with a better defined naked tract below the nostrils, a well-developed philtrum mesially grooved, broad at the base, and narrowed below where it reaches the inferior edge of the upper lip; the nostrils are more expanded with the upper lid more swollen, so that from the anterior aspect the upper edge of the rhinarium appears to be biconvex with an angular median depression and from the dorsal aspect the anterior edge is seen to be transversely truncated. The hairs of the upper side of the nose extend some distance between the nostrils, although not so far as in *Oryx*, so that the posterior border of the rhinarium is strongly concave.

The *penis* (fig. 4, E) resembles that of *Agoryx*, described above, in the thickness, length, and freedom of the tubular prolongation of the urethral canal, but the termination of the glans is less markedly bulbous.

The Orygine, apart from *Addax* which requires examination, are a remarkably uniform group with respect to the

structure of the penis, the presence of four mammaræ, the absence of inguinal glands, and the presence on all four feet of flask-shaped pedal glands with narrow exit passage and small circular orifice just behind the summit of the interungual web.

Fig. 5.



A. Muzzle and rhinarium of *Hippotragus niger* from the front.  $\times \frac{1}{2}$ .  
B. The same from above.

Setting *Addax* aside, the genera discussed in this paper may be distinguished as follows:—

- |   |                      |
|---|----------------------|
| a. Rhinarium sculptured, with distinct philtrum reaching lower edge of upper lip; upper rim of dilated nostrils swollen; horns rising erect from head . . . | <i>Hippotragus</i> . |
| a'. Rhinarium smooth, without philtrum, upper lip entire; upper rim of narrow nostrils not swollen; horns inclined backwards in the plane of the forehead.  |                      |
| b. Preorbital gland present as a thickened pad of skin like that of <i>Hippotragus</i> ; rhinarium shallow; horns curved . . . . .                          | <i>Ægoryx</i> .      |
| b'. Preorbital gland absent; rhinarium deeper; horns straight . . . . .   | <i>Oryx</i> .        |

*Addax* differs from the three above enumerated genera in having broad rounded hoofs, the interdigital web exceedingly thick above, the pedal glands represented by a short narrow cylindrical tube, corresponding to the duct of the gland in *Hippotragus* and *Oryx*, and the horns spirally twisted (Proc. Zool. Soc. 1910, pp. 910-911).

XXV. — Descriptions from the Joicey Collection of new Species of Syntomidæ, Nymphalidæ, and Hesperidæ, and Two Genera of Syntomidæ. By W. J. KAYE, F.E.S.

ALL the new species herein described will be figured after the war. The striking new *Chlorippe* from Haiti is so far unique. It is a ♀ and could scarcely be a ♀ ab. of *cherubina*, the species it doubtless comes closest to. In Cuba *Chlorippe laure* occurs, but the present insect is certainly not a ♀ of that species, although it is highly possible that *laure* occurs in Haiti.

The new race of *Anax xenocrates* from French Guiana, although different in the ♂ from the typical species, has a ♀ (only a single specimen) that is exceedingly like the ♀ at Ting of the type-form from Bolivia. The female of this species appears to be exceedingly rare, and it was rather surprising to get a single pair from quite a new locality.

Syntomidæ.

TIGRIDANIA, gen. nov.

Proboscis well developed. Palpi long, upturned, reaching well above head, and separated widely at base, but meeting above the head. Antennæ bipectinate in both sexes, longer in ♂. Legs fairly long. Hind tibiæ with two pairs of spurs of nearly equal length and strong spines on the tarsal joints. Fore wing with vein 3 a long way before end of cell and distance between veins 2, 3 less than that between 3 and 4. Veins 4, 5 from angle of cell; a fold between 5, 6, extending across cell; 11 from cell; 7, 8, 9, 10 stalked. Costa greatly bulged at base. Hind wing with the lower discocellular very short and oblique; veins 2 and 4 on a long stalk, 3 absent, 5 present, 6 and 7 from upper angle.

Type, *quadricincta*, Kaye.

The genus comes nearest to *Sarosa*, from which it differs markedly in the position of veins 2 and 3 of the fore wing.

*Tigridania quadricincta*, sp. n.

Fore wing smoky transparent, with the costa broadly black from before discocellular to apex, which is very broadly black. Discoidal spot black; outer margin with an extension inwards along vein 2, and inner margin with an extension along vein 1  $\delta$  heavy black. Hind wing bluish transparent with hardly any smoky appearance; outer and inner margins heavily black and costa clothed with pale yellowish hair. Abdomen with four yellowish segmental rings. The last four segments black. Fore coxæ whitish beneath. Frons white; gulae pale yellowish; tegulae with two pale yellowish spots. Mesothorax with a long central pale spot and patagia with a pale area at base and a pale stripe beyond middle. Metathorax with two pale spots.

Expanse 66 mm.

*Hab.* Upper Amazons, Rio Ucayali.

Type in Coll. Joicey.

*Autochloris crinopoda*, sp. n.

Head black with blue scaling at vertex; tegulae black with blue patches; shoulders with white spots. Thorax and patagia black. Abdomen black with indistinct sublateral blue patches; last four segments crimson. Hind tibiae with dense orange tufts of hair. Fore wing hyaline with heavy black margins; a heavy black discoidal blotch and a similar blotch between cell and inner margin. Hind wing hyaline, with the outer margin broadly black and a small black discoidal mark. Abdomen below with only the last two segments crimson. Fore coxæ with exterior patches of white scales.

Expanse 41 mm.

*Hab.* Cayenne.

1 ♂.

*Ab. lutea*, nov.

Abdomen with the last three segments yellow, the fourth only yellow laterally.

*Hab.* Ecuador, Sarayacu (*C. Buckley*).

*Saurita pebasa*, sp. n.

Head black, tegulae black; patagia with large red patches; shoulders with red patches. Abdomen black. Fore wing smoky black, darker about the discocellulars and with a pale

transverse area across the disc. Hind wing smoky black, darker at apical area and inner margin.

Expanse 22 mm.

*Hab.* Peru, Pebas Loreto, 1913.

*Chrostosoma guianensis*, sp.

Head black with some blue scaling behind the eyes. Thorax black; patagia with red spots and a red spot on the shoulder. Metathorax with a blue spot. Abdomen black, legs and palpi black. Fore wing hyaline, smoky, with dark scaling at base, along inner margin, and at apex. Hind wing smoky hyaline, with apex and inner margin narrowly darker.

Expanse 28 mm.

*Hab.* British Guiana.

*Chrostosoma halli*, sp. n.

Head and thorax black. Shoulders with red patches. First abdominal segment with a pair of sublorsal red spots. Abdomen black with some metallic-green scaling, especially on last three segments. Abdomen beneath white on first three segments and with orange sublateral patches on fifth and sixth segments. Fore wing yellowish hyaline, with the costa narrowly black beyond the cell and with the apex black. Outer margin very narrowly black. Hind wing yellow hyaline; outer margins narrowly black, becoming broader at anal angle.

Expanse 33 mm.

*Hab.* Guatemala, Barrios, 22. xii. 12 (*A. Hall*).

*Pheia serpens*, sp. n.

Head black; frons metallic green. Tegulae orange with a few blue-green scales. Patagia orange. Coxae vermilion-red. Abdomen above orange with a broad expanding median stripe of blackish brown. Abdomen beneath with a large white valve covering the basal segments. Last five segments black-brown. Fore wing with costa as far as discoidal cell orange, and inner margin for half the distance orange. Wings hyaline. Discoidal spot black, rather rectangular. Outer margin broadly black; apex broad, black. Hind wing transparent, the margins black. Antennae with the tips white.

Expanse 26 mm.

*Hab.* Lower Amazon, Serpa, Jan.-Mar. 1914 (*A. Hall*).



*Pheia nanata*, sp. n.

Head black with vertex of head, *tegulae*, *frons*, and shoulders with metallic-green spots. Abdomen with first segment with sublateral red spots and a series of faint dorsal green spots. Fore coxæ brilliant vermillion-red. A large white valve covering basal segments beneath. Fore wing transparent with costa, discoidal spot and outer margin black, the last broad at apex and expanding inwards at vein 2. Hind wing with the costa and cell filled up with dark scaling. Apex rather broadly black.

Expanse 26 mm.

*Hab.* Peru, Rio Pacaya, Lower Ucayali, Aug.-Sept., 1912.

Related to *Pheia hæmapera*, Schs.

*Rhyncopyga discalba*, sp. n.

Frons black, vertex of head black. Collar orange, *tegulae* orange. Thorax and abdomen black. First two joints of palpi orange. Coxæ and valve covering basal segments white. Underside of last five abdominal segments orange. Fore wing with the basal half transparent. Discal half of wing dull black, containing a large white discoidal spot. Median vein heavily scaled with blackish. Hind wing transparent with a broad black apex.

Expanse 19 mm.

*Hab.* Panama, Bugaba.

Related to *R. flavicollis*, Druce.

*Cosmosoma ochreipennis*, sp. n.

Palpi orange; frons yellowish. Blue spots behind antennæ. *Tegulae* black with metallic-blue spots. Patagia black with a central orange streak. Hind tarsus black above, orange beneath. Thorax black. Abdomen black, segmented with orange and with subdorsal metallic-blue spots, the last five segments with a subsidiary second row of blue spots. Fore wing transparent yellowish, the costa yellow, apex broadly black, and outer margin narrowly black, wider at tornus. Hind wing transparent yellowish with a narrow black outer margin.

Expanse 32 mm.

*Hab.* Peru, Contamana, Rio Ucayali, xi.-xii. 1912.

*Gymnelia semicincta*, sp. n.

Frons black, between antennæ bluish black. *Tegulae* with brilliant blue patches. Patagia black. Thorax black.

Abdomen with first segment above orange, becoming paler at sides. A broad black dorsal fascia running down the remaining segments, edged on the sides with orange segmental bands and interspaces of bluish scales, especially on the sixth and seventh segments. Fore wing with a small bunch of white scales at base. Costa yellowish, becoming orange beyond the cell. Inner margin orange on basal half. Outer margin black, the apex very broad, the remainder very narrow. Wing-membrane yellow. Hind wing slightly less yellow than fore wing. Inner margin rather broadly black, outer margin narrow.

Expanse 25 mm.

Hab. Colombia, Valparaiso.

*Mesothene demicostata*, sp. n.

Palpi black; vertex of head metallic blue-green; legs orange. Tegulae and patagia edged orange. Metathorax and first five segments of abdomen with orange segmental bands. Fore wing yellowish transparent. Costa on the central area bright orange; basally and on apical third black. Apex rather narrowly black and outer margin very narrowly black. Inner margin narrowly orange, except at base, which is black. Hind wing yellowish transparent, with outer margin narrowly black.

Expanse 28 mm.

Hab. W. Colombia (San Antonio), 5800 ft., Nov. 1907 (M. G. Palmer).

*Rhyncopyga semirufa subochrea*, subsp. n.

Fore wing lighter, more ochreous than in *semirufa*. No dark discoidal mark and with the dark marginal band greatly narrowed at tornus. Between discocellulars and marginal band a broad ochreous shade. Hind wing paler than *semirufa* and with a slightly narrower marginal band. Fore wing below with distinct ochreous postdiscal band.

Expanse 26 mm.

Hab. N. Peru, River Tabaconas, 6000 ft. (A. E. & F. Pratt), 1912.

PSEUDODIPTERA, gen. nov.

Proboscis absent; palpi slightly downcurved; antennae bipectinate, with long branches. Thorax and second segment of abdomen clothed with hair. Fore wing long; vein 3 long before end of cell; 4, 5 on a short stalk; 6 from middle of discocellulars, curving down greatly towards vein 5; 7, 8, 9, 10, and 11 stalked. Hind wing small, greatly cut away

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at apex; veins 3 and 5 widely separated, 4 absent, 6 absent. A short veinlet in the cell.

Type, *musiforme*.

*Pseudodiptera* comes nearest to *Apisa*, from which it differs in having veins 3 and 5 of hind wing widely separated at origin and in having vein 6 of fore wing from middle of discocellulars.

*Pseudodiptera musiforme*, sp. n.

Palpi black; frons with large white spot. Head black with metallic-blue spot between antennae. Tegulae with white patches. Patagia black with white spot at base of wing. Below, fore coxae white and white patches at base of tibiae. A broad orange stripe on underside of abdomen. Abdomen above black with dark green metallic segmental bands. Fore wing transparent, the margins narrowly black. Discoidal spot narrowly black, connected with outer margin by a short black streak along vein 5. Inner margin with a black extension inwards midway. Hind wing transparent, with the costa and cell filled up with blackish.

Expanse 24 mm.

\*1 ♂.

Hab. Congo, Oubangui-chari, Tschad.

Type in Coll. Joicey.

Family *Hesperiidae*.

Subfamily *Pamphilinae*.

*Pseudosarbia campicola*, sp. n.

Head, thorax, and abdomen dull brownish black. Fore wing above dull brownish black, with a broad, macular, creamy-whitish, transparent, median band, commencing on costa as a small whitish dot succeeded by a rather square spot within the cell; a much larger and more transparent spot between veins 2, 3, and a creamish-white, more opaque spot lying beneath, but not reaching the inner margin by about 1-2 millimetres. Cilia same as the ground-colour, except for a large white area at tornus. Just beyond cell is a broad regular white band from costa to vein 4, with the veins showing through brownish. Between veins 3, 4 near cell is a small white comma-like mark. Fore wing below as above, except that instead of a small white dot on costa at commencement of band there is a pale yellow streak.

Hind wing above dull brownish black with a broad white band from vein 8 to vein 2 divided up into sections by the dark brown veins. Cilia at apex brown, becoming white thence to tornus, where it is considerably longer. Hind wing

below as above, except for a straight yellow streak within the cell which runs beyond the discocellulars along the fold in place of vein 5.

Abdomen beneath with paired white spots on sternites 4, 5, 6, 7, and 8.

♀. Like the male, except that all the white markings are broader.

Expanse, ♂ 52 mm., ♀ 58 mm.

Hab. S. Brazil, Parana, Ponta Grossa, 1 ♂, 30. 3. 1910 (W. J. Kaye). Uruguay (E. Trimen).

♂ type in Coll. Kaye. ♀ type in Coll. Joicey.

The habitat of this striking "skipper" is open grassy campo in S. Brazil at 3000 ft. elevation. Hardly another butterfly was to be seen where the ♂ was caught, although a close search was made at the time for further specimens of what I recognized at the time as a rarity.

On the label of the ♀ specimen labelled Uruguay it is stated "Mr. W. C. Hewitson had this Hesperid from me [Rowland Trimen] to describe and figure together with the specimen of *Papilio hellanichus* (also from Uruguay); but although he attached to it the label '*Apheka*' I have not found that he published any description or figure of it.—R. Trimen."

The type of *Papilio hellanichus*, once in the Trimen collection, was acquired with the whole collection by Mr. Joicey.

#### Family Nymphalidæ.

##### *Chlorippe speciosissima*, sp. n.

♀. Fore wing ochre-yellow with two black transverse marks, the one within the cell flat V-shaped, the other lying along discocellulars. A pale transverse band across disc, straight to vein 3, then set back and broken; a conspicuous blackish spot surrounded with reddish ochreous near tornus between veins 2 and 3. A dark shade in subapical area containing two pale round spots. Subterminal black line regular preceded by a crenulated black band which merges in the dark subapical area. Hind wing ochre-yellow with a small round black spot within the cell, lying close to origin of vein 7. Costal area brownish black with a square whitish patch in middle, which represents the end of a transverse band which is almost obliterated. A large black spot surrounded with reddish ochreous between veins 2, 3. Subterminal line black, regular to vein 2, where it is strongly toothed and edged externally with grey. A heavy black inner crenulated band also strongly toothed at vein 2. Outer margin crenulated. Underside of hind wing pinkish silvery

with the upperside markings showing through, and with a well-defined central whitish band becoming more or less merged with the ground-colour at anal angle.

Expanse 82 mm.

*Hab.* Haiti, no precise locality.

Type in Coll. Joicey.

*Anæa xenocrates punctimarginalis*, subsp. n.

♂. Differs from *xenocrates xenocrates* from Bolivia in the fore wing by having no blue scaling at tornus and in the blue subapical spots being widely separated and showing no tendency to unite inwards. Hind wing with a series of rather small triangular blue marginal spots, not a band as in the Bolivian form.

♀. Shows much less difference from type-form. The margin of hind wing is yellow banded as in the ♀ from Bolivia. There is an extra yellow spot between veins 3, 4, smaller than that between veins 2, 3.

Expanse 82 mm.

*Hab.* French Guiana, St. Jean de Maroni.

• 1 ♂, 1 ♀.

Type in Coll. Joicey.

The occurrence in French Guiana of a species only known hitherto from Bolivia and the Upper Amazons (Pebas) is strange, and at first suggests specific difference and not subspecific. But the species is rare, the ♀ exceedingly so, and its range may lie across the interior of Brazil where it could easily remain undetected. The species has been chiefly known from Eastern Bolivia, but the few specimens known from Pebas belong to the same form with a blue marginal hind-wing band in the ♂.

XXVI.—*Observations on the Genus Lysorophus*, Cope.

By ROBERT BROOM. With a Note, by Prof. W. J. SOLLAS.

So much has already been written about this little vertebrate by Broili, Case, v. Huene, Moodie, Finney, and Williston that it might seem doubtful wisdom to add another paper to the already extensive literature, and more especially as my observations are on specimens already carefully examined by Case and v. Huene; but when one considers that *Lysorophus* is the most remarkable land vertebrate that has been discovered for many years, and that opinions not only differ as to its affinities but also as to the interpretation of a number of the cranial elements, a further review of even the present evidences seems justifiable.

There is no lack of material. The Chicago Museum has 200 nodules, each containing much of the skeleton of a specimen: the American Museum, New York, also has many nodules, and in the American Museum nine skulls have been chiselled out, one or two in very good condition. In Tübingen there are 24 skulls, and at Munich a considerable number more.

As the extensive literature has been reviewed by Williston and others, it will be unnecessary to enter into this in detail. To Broili we owe the first really good figures of the skull, but there are one or two points in his interpretation that I, in common with all later writers, do not accept, and from his conclusion as to the affinities of the genus I also differ.

Case gives a brief description of the more conspicuous elements of the skull, and reproduces Broili's and Williston's figures. As these two figures differ in a number of points, one could have wished that Case had given an original figure of his own interpretation, and his description, while pointing out the different views, does little to clear up the matter.

Williston gives us clear definite views as to the structure of the skull and skeleton, and equally clear opinions as to the affinities of the genus.

Von Huene, the latest worker on the genus, has just issued a paper on *Lysorophus* in the 'Anatomischer Anzeiger,' and another paper is in the press describing the specimens in the American Museum. Though these two papers are appearing in the same year, I believe that the one in the 'Anatomischer Anzeiger' to be the later. On one or two points the opinions expressed differ in the two, and it is therefore well to know which is the latest. Von Huene has figured a number of the better skulls in the American Museum, and gives us clear opinions not only on the structure, but also on the affinities of the genus.

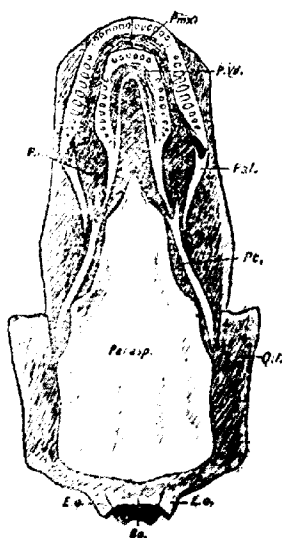
The skulls in the American Museum, though comparatively few in number, are mostly well preserved, and there is scarcely a point in the structure that cannot be made out in one or other.

The best figures published of the top of the skull are those of Broili and Williston, and they differ, apart from interpretations, only in the relative width of the nasal region. While neither is altogether correct, a composite of the two would give the truth. The difference arises from the peculiar state of affairs in front of the prefrontal. Broili correctly recognises a round opening here which he regards as the nostril. It is also shown in Williston's specimen. The most natural conclusion would seem to be that this is

the nostril, but two of the American Museum specimens seem to indicate that the opening extends somewhat inwards and forwards, and one would like to see a specimen showing the perfect snout to feel quite sure that this opening is the nasal opening and not perhaps also an opening for some sensory organ.

There is a small premaxilla—possibly toothed. It is figured by v. Huene. The maxilla is slender and carries about ten teeth. Its posterior end articulates, I believe, with the palatine. It forms the floor of the nasal opening

Fig. 1.



Restoration of the underside of skull of *Lycorophis tricarinatus*,  
Cope,  $\times 5$ .

and perhaps its posterior border. The doubt lies in the fact that in the specimens it is impossible to be quite sure whether the bridge of bone which connects the prefrontal with the maxilla is a part of the prefrontal or a part of the maxilla or a small independent bone.

One specimen shows most of the palate. The bones are a little crushed and fractured, and the interpretation I give is made with some hesitation (fig. 1). Von Huene figures the specimen, but his interpretation differs somewhat from mine,

which agrees pretty closely with Broili's. I consider v. Huene in error in regarding that there are "two large, elongate internal nares, separated by a narrow bridge." The large supposed left choana of v. Huene I regard as the median vacuity between the prevomers, and the narrow bridge as the right prevomer. The figure I give will show how I interpret the palatal structures. The prevomers form a horseshoe-like arrangement with posterior processes passing back to the parasphenoid and apparently articulating with the pterygoids. The teeth on the prevomers are well shown in this specimen. In front there are about 6 and about 8 on each side. The palatines are delicate bones extending from the maxillæ to the pterygoids. Between the palatines and prevomers are, I believe, the internal nares. The pterygoids extend back as rather delicate bones to meet the quadrates. The parasphenoid is a very large bone, which forms nearly the whole of the base of the posterior two-thirds of the skull. The supposed suture figured by v. Huene between the parasphenoid and the basisphenoid is, I think, a fracture merely.

The figure I give of a transverse section of the skull (fig. 3) shows the relations of the pterygoid to the parasphenoid, and also the elements of the back of the mandible.

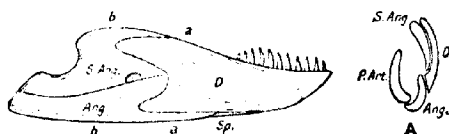
In Broili's figure A of the side view of the skull, there are seen in the orbital region some deep-seated elements. These are also shown in two of the American Museum specimens. In what might be regarded as the sphenethmoid region there appear to be three elements with a deep posterior notch. In one of the New York specimens an almost exactly similar appearance is shown, and further back an elongated element very like an epipterygoid in appearance. Though these elements have been seen by Broili, neither he nor anyone else appears to have expressed any opinion as to what they were. After considering many possibilities I have come to the conclusion that they are ossifications or calcifications in the cartilaginous brain-case. The anterior elements look as if separated by sutures, but, whereas all true sutures in the skull and even cracks are filled with the red clayey matrix, these divisions are formed of clear calcite which probably indicates that they were originally formed by hyaline cartilage. Further, in a second specimen the ossification appears to be entire. The posterior narrow vertical element is also, in my opinion, an ossification of the cranial cartilage. It certainly has much superficial resemblance to a reptilian epipterygoid. It articulates with the parietal above and passes down to at least near to the pterygoid. It thus answers in position to the epipterygoid.



But though in front it has a smooth edge the posterior edge is irregular, as if indicating an ossification in cartilage. The anterior ossification or ossifications probably correspond to the sphenethmoid of *Siredon* or the frog, and the posterior to the ossification seen in Dinosaurs, Crocodiles, and birds, and usually, but I think wrongly, called alisphenoid.

The quadrate is large and its upper half is largely hidden by the squamosal. There need not, I think, be the slightest

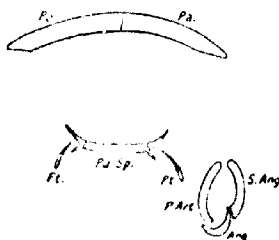
Fig. 2.



Lower jaw of *Lysorophus tricarinatus*, Cope,  $\times 5$ . A represents a section at *a a*.

*Ang.*, angular; *D*, dentary; *P. Art.*, prearticular; *S. Ang.*, surangular.

Fig. 3.



Section across skull and jaw of *Lysorophus tricarinatus*, Cope,  $\times 5$ . The section of the lower jaw is near the point indicated by *bb* in the figure of the jaw. The outer corners of the parasphenoid are separated by cracks or sutures. They are believed to be parts of the parasphenoid.

*Ang.*, angular; *Pa.*, parietal; *Pa. Sp.*, parasphenoid; *P. Art.*, prearticular; *Pt.*, pterygoid; *S. Ang.*, surangular.

doubt about this bone being the squamosal—the view also held by Williston and v. Huene.

The occiput has recently been figured by v. Huene from one of the American Museum specimens and also from one of the Tübingen specimens. His drawing of the American Museum specimen is not in my opinion quite accurate, the American specimen agreeing closely with his figure of the Tübingen specimen. The main difference between the two

is that in the drawing of the American specimen the exoccipital is represented as very small. This is, I think, wrong, the exoccipital being large, as represented in the drawing of the Tübingen specimen. The drawing v. Huene gives of the occipital condyle is thoroughly satisfactory, showing that the articulation is as much basi- as exoccipital. Von Huene's identifications of the fenestra ovalis and foramen for the vagus are probably correct.

The large bone situated by the sides of the supraoccipital has been very variously identified. By Broili and Case they have been called squamosals, by Williston epiotics, and by v. Huene supratemporals. That they cannot be squamosals requires no argument, the undoubted squamosals lying in front. Nor can they, I think, be regarded as supratemporals. From their being quite behind the parietals, and at the sides of the supraoccipital and far behind the jaw, it is very doubtful if they in any way roof the temporal region. They may be epiotics, but we do not know any forms in which epiotics take up this position. They further appear to overlap the supraoccipital, and to be thus membrane bones. It seems to me that they, however, answer all the requirements of the tabulares. They lie on the outer part of the paroccipitals, are behind the parietals, and articulate with both the parietals and squamosals, and to form the upper lateral parts of the occiput.

The lower jaw has never been fully described. Von Huene figures one of the specimens in the American Museum, but with one or two of his interpretations I do not agree. He has also examined some jaws in the Tübingen Museum, but they have apparently not yielded any fresh light. The American Museum specimen, no. 4761, shows something of the jaw, but not nearly so much as two other specimens not numbered. Between these three specimens practically all details can be made out (fig. 2).

The dentary forms about two-thirds of the jaw. It comes to a sharp point in front and forms with its neighbour a short feeble symphysis. It articulates on the outer side behind with the surangular and angular. The splenial is a small bone lying on the inside of the lower part of the dentary just behind the symphysis. It forms the lower margin of the jaw in this region. The angular forms nearly the whole of the lower border of the jaw, passing in front between the dentary and the splenial. From two of the American Museum specimens I incline to differ from v. Huene, and believe that the splenial does not form part

of the symphysis. The surangular forms the upper half of the back of the jaw as indicated in the figure. Von Huene is, I think, in error in regarding the large opening in the side of the jaw in specimen 4716 as natural. Only a small part is, I believe, a natural opening, the rest due to faulty preparation. In other specimens the lateral opening is quite small, as indicated in the figure. I find no evidence of a coronoid element. Inside the jaw is a large prearticular. The articular is evidently quite small, and possibly cartilaginous.

Though the structure of the skull of *Lysorophus* may now be said to be pretty well known, there is still some little doubt as to the affinities. *Lysorophus* agrees closely with no known animal, recent or extinct. With Williston I agree in holding that *Lysorophus* is not a reptile. All known reptiles are either Cotylosaurs or are manifestly derived from Cotylosaurian ancestors, but *Lysorophus* is neither a Cotylosaur nor can it have been derived from a Cotylosaur. The supposed reptilian resemblances are entirely fallacious. Von Huene in his recent paper, though correctly figuring and describing the occipital condyle, says: "this condyle is intermediate between the true reptilian condyle and the true amphibian condyle . . . . The structure of the condyle shows a great resemblance to that of the Theromorphs and of Turtles." In Theromorphs and Turtles the condyle is a tripartite condyle, of which the upper two-thirds are formed by the exoccipitals and the lower third by the basioccipital. In most Chelonians and Theromorphs the exoccipitals come close together, and the basioccipital is squeezed out from the foramen magnum. In all generalised forms the condyle is a projecting rounded structure which articulates with the arches of the atlas and with the intercentrum. In *Lysorophus* the whole articulation is with the centrum of the atlas, which fits close into the broad hollowed out surface formed by the basi- and exoccipitals. The presence of a large articular surface on the basioccipital seems at first sight to be a non-Amphibian character, but, as Watson has recently pointed out, this is the primitive Amphibian condition. The early Stegocephalians of the Lower Carboniferous, such as *Pteroplax*, have the basioccipital forming practically the whole of the articulation, the exoccipitals only very gradually in later forms taking the place of the basioccipital. So that, so far from the occipital condyle of *Lysorophus* indicating any reptilian affinities, it is really in a more primitive condition than is found in any other Permian or later Amphibian.

Doubtless Williston is right in regarding *Lysorophus* as a mud-borrowing animal, and many of its specialisations are due to this habit, such as the greatly elongated snake-like body with very numerous vertebrae, great reduction of the limbs, relatively small size of skull, loss of the arches, and advanced position of the quadrate. And the somewhat similar characters, acquired by convergence in other groups which have similar habits, have given rise to some striking superficial resemblances to *Lysorophus* in the Gymnophiona, the Amphisbænans, and the Typhlopida.

But, apart from all modifications in *Lysorophus* due to a burrowing habit, the skull is undoubtedly fundamentally an Amphibian skull, and the only known Amphibia, recent or extinct, with which it seems at all allied are the Urodela, and, more remotely, the Anura and the Gymnophiona.

*Note by Prof. W. J. SOLLAS.*

Some years ago Dr. Broom obtained, through the kindness of Dr. Matthew, two specimens of *Lysorophus*, and these he presented to me for investigation by serial sections; at the same time he made a most generous addition to this gift by placing in my hands, to dispose of as I thought fit, a paper embodying the important conclusions to which he had been led from his study of the specimens in American museums.

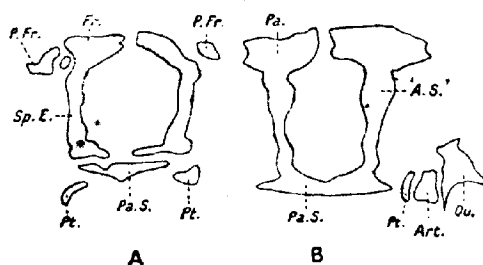
My own study is now completed, and I hope soon to give a full and exact account of the structure of the skull in all its details. This will confirm all the more important conclusions of Dr. Broom, and in justice to him I can no longer withhold from publication the paper which he entrusted to me in 1914.

One or two minor emendations ought, perhaps, to be made. Thus, the vacuity between the vomers, as it is represented in fig. 1, does not really exist; these bones are without thickened margins and meet in the middle line; and, again, the articulare of the lower jaw is a comparatively large and important bone.

On the other hand, there can be no doubt that the cranial walls include, as Dr. Broom suggests, a large "sphenethmoid" and "alisphenoids." These are shown in section in the accompanying figures (figs. 4 & 5).

The whole anatomy of the skull recalls in a striking manner that of *Siren* or *Menopomus*, and to my mind *Lysorophus* is without doubt an ancestral Urodele. It presents some remarkably interesting primitive characters.

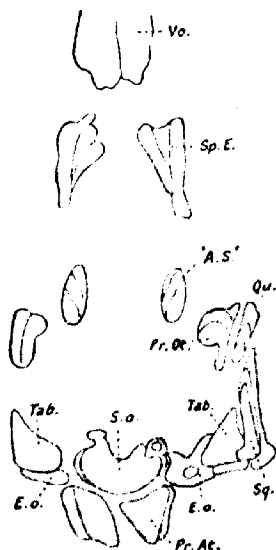
Fig. 4.



Transverse sections of skull of *Lysorophus*, to show the sphenethmoid and "alisphenoid" bones.

A. Sphenethmoid: *Fr.*, frontal; *Pa.S.*, parasphenoid; *P.Fr.*, prefrontal; *Pt.*, pterygoid; *Sp.E.*, sphenethmoid. B. "Alisphenoid" ('A.S.'): *Art.*, articulare of lower jaw; *Pa.*, parietal; *Qu.*, quadrate.

Fig. 5.



Three horizontal sections superposed.

*Vo.*, vomers; *Pr.Ot.*, pro-otic; *Sq.*, squamosal; *S.o.*, supra-occipital; *Ex.o.*, exoccipital; *Tab.*, tabular; *Pr.Ac.*, pro-atlas.

THE ANNALS  
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[NINTH SERIES.]

No. 10. OCTOBER 1918.

XXVII.—*On the Races and Variation of the Edible Frog,*  
*Rana esculenta, L.* By G. A. BOULENGER, F.R.S.

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AFTER all I have written in the past on this common Batrachian, it may seem surprising that I *should* think it worth while to revert to the subject. The reason is that it is far from exhausted; that I have never ceased accumulating material\*, in the course of recently reviewing which I perceived characters hitherto overlooked; that it was desirable to test the value of certain differences appealed to within the last few years by advocates of the extreme multiplication of species; and that it is always useful to deal with individual variations, when large series of specimens are available, in order, by showing the instability of certain characters, to ensure a more correct appreciation of their importance when treating of allied species represented by less extensive material. Not that I think inconstancy in one case invariably follows in another, but such examples teach caution, and should be a warning to the inexperienced.

Considering modern tendencies in zoography, it cannot be too often repeated that the method of describing so-called species and subspecies from single specimens† or from at

\* About 800 specimens are now before me, selected from at least twice as many that have passed through my hands.

† "On aura beau multiplier les espèces, on arrivera toujours à ce résultat que la description exacte d'un sujet pris au hasard, parmi six cents récoltés sur des points divers d'un même rivage, ne pourra convenir à aucun des cinquante neuf autres." Duval-Journe, *Mém. Ac. Montpellier*, vii. 1871, p. 511.

most a very few, when large series can be examined, or without reference to the data available through the labours of other investigators, is unfair to those who make use of works written on such lines. Systematics, if scientific, must take into full consideration the exceptional, aberrant, or annectant specimens, so often passed over without a word, though of so great an importance from the taxonomic and evolutionary points of view. It does not matter if thereby our definitions are obscured, the object to be attained is to depict the true state of things in Nature.

To the four forms which I have previously \* distinguished, as forma *typica*, var. *ridibunda*, Pall., var. *lessoner*, Camer., var. *chinensis*, Osb., I have recently added a fifth, var. *saharica* †, founded on specimens obtained by Dr. E. Hartert in the far interior of the Algerian Sahara (El Golra, Tchikel cases), a small race nearly related to the var. *ridibunda* of the northern parts of Algeria but differing in the shorter tibiae, constantly less than half the length of head and body and not overlapping when the limbs are folded at right angles to the body; the membrane between the toes is very deeply notched, so much so that many specimens may be described as having the foot only three-fourths webbed.

#### The Vomerine Teeth.

I have never seen these teeth in two series on the round or elliptic bony bases that bear them, as described and figured by Fatio ‡. They form a single series, composed of 3 to 8; in exceptional cases I find only 1 or 2 teeth (specimens of the typical form from St. Malo, Brussels, and Basle). Leydig § gives the number 3 as normal, but he cannot have examined many specimens, those on which he drew up his description being probably mostly of the var. *lessoner*, as the figure of the foot given in his book indicates, and this number is very frequent in the variety in question, although it may rise to 5. In 8 frogs of the typical form from Basle I find only 2 to 4 teeth, whilst in 35 from other parts of Switzerland, from France, and from Germany I count 3 to 7, 4 to 6 being the usual number; I have also seen a toothless specimen from Vienna. In about 30 specimens of the var. *ridibunda* from Germany and Austria I count usually 4 to 6 teeth; 3 specimens have only 3, one has 7 on one side and

\* Proc. Zool. Soc. 1891, p. 374, and Taill. Batr. Eur. p. 270 (1898).

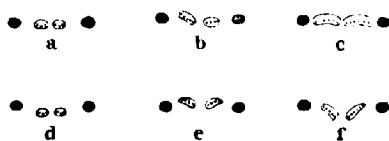
† Nov. Zool. xx. 1913, p. 84.

‡ Vert. Suisse, iii. p. 313, pl. v. fig. 7 (1872).

§ An. Batr. Deutschl. p. 112, pl. iii. fig. 20 (1877).

8 on the other, and one (from Vienna) has but a single tooth. 3 to 5 is the usual number in the var. *chinensis*. The series of teeth are usually nearer to each other than to the choanæ, but they are sometimes equidistant in the typical form and the var. *ridibunda* and usually so in the var. *saharica*; an arrangement such as is represented on the figures in Schreiber's book\* I am sure never occurs. In a female from Cadillac, Gironde (var. *ridibunda*) the teeth form long, slightly curved series, extending almost right across the space between the choanæ. The series are sometimes horizontal, sometimes more or less oblique though seldom very

Fig. 1.



Vomerine teeth in specimens from St. Malo (a, b), Cadillac (c), Basle (d), Oporto (e), and Dead Sea (f).

much so; a male from St. Malo has the series oblique on the right side, horizontal on the left. The teeth are usually exactly between the choanæ, but they may extend backwards beyond a line connecting the posterior borders of the latter, or, more exceptionally, they may be on a line with their anterior borders (specimens from Oporto and Pekin). There is no difference whatever in the disposition of the vomerine teeth that could help in the definition of the various forms of *R. esculenta*.

### The Tongue.

The tongue varies much in size: it may nearly cover the floor of the mouth or its width may be only about one-third that of the latter. Bedriaga† has already mentioned that the posterior processes also vary much in length according

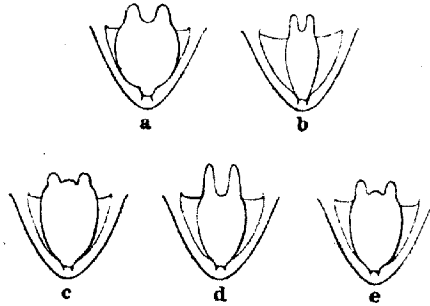
\* 'Herpetologia Europæa,' 2nd ed. (1912).—So much in this book is merely careless compilation that I need not further allude to it except to express amazement at the suggestion there made that the Spanish-Portuguese frogs named vars. *koyanica* and *perezi* may be the same as the var. *lessonae*; also at reading that the males of *R. græca* and *R. iberica* are distinguished from those of allied species in having external vocal sacs.

† Lurche fauna Europa's, i. p. 36 (1891).



to individuals; this is well shown by two specimens from Florence, representing the two extremes. A more or less distinct process between the two horns is sometimes present, as in a specimen of the var. *lessonæ* from Noville, Switzerland\*.

Fig. 2.



Showing the shape of the tongue in specimens from Berlin, var. *ridibunda* (a, b), Florence, f. *typica* (c, d), and Noville, var. *lessonæ* (e).

### The Head.

According to Bolkay †, the three forms distinguished by him as species differ in the following points:—

*R. esculenta*. Head comparatively narrow, tip of snout ending in a blunt point; interorbital space equal to half, or frequently to three-quarters, the breadth of the upper eyelid.

*R. ridibunda*. Head broad, short, tip of snout bluntly rounded; interorbital space equal to one-third the breadth of the upper eyelid.

*R. chinensis*. Head narrow, long, and very pointed at the end; interorbital space equal to half the breadth of the upper eyelid.

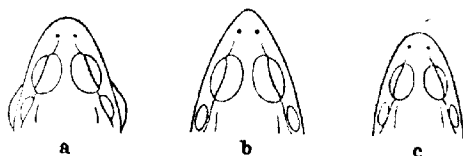
There is no constant difference in the shape of the head between the two first, and although it is a fact that *R. chinensis* usually has a narrower head and a more pointed snout,

\* This process is usually distinct in the Indian *R. hexadactyla*, Less. It has been regarded as a specific character in a Central American frog (*R. trilobata*, Mocquard), which may be merely a young *R. hualcaina*, L.

† Proc. Washingt. Ac. Sc. xiii, 1911, p. 75.

this is by no means always so, and specimens are to be found in which the snout is much more rounded than in some *R. ridibunda*. I have selected three specimens, of which outline figures are here given, to show that the above definition of the three forms cannot be relied upon.

Fig. 3.



Upper views of heads of typical form, ♂, St. Malo (a); var. *ridibunda*, ♀, Capljina, Herzegovina (b); and var. *chinensis*, ♀, Broughton Bay, Corea (c).  $\frac{2}{3}$  nat. size.

The width of the head varies between 1 and  $1\frac{1}{2}$  times its length in the typical form (28 : 32 in ♀ from Havre), between 1 and  $1\frac{1}{2}$  times in the var. *ridibunda* (= in some specimens from Herzegovina, France, Portugal, Algeria, Asia Minor, Persia, 36 : 43 in ♀ from Kiev), between 1 and  $1\frac{1}{2}$  in the var. *chinensis*. The width of the interorbital space is  $\frac{1}{3}$  to  $\frac{1}{2}$  that of the upper eyelid in specimens of the typical form from St. Malo and Paris,  $\frac{1}{4}$  to  $\frac{3}{8}$  in others from Poitiers. In the var. *ridibunda*, taking only specimens from Germany and Austria-Hungary into consideration, it is between  $\frac{1}{4}$  and  $\frac{1}{2}$ , but it may be exceptionally  $\frac{3}{8}$  (♂ from Laaserberg near Vienna);  $\frac{5}{8}$  (in a large ♀ from Damascus) is another exception. In the var. *chinensis* it varies between  $\frac{2}{5}$  and  $\frac{3}{4}$ .

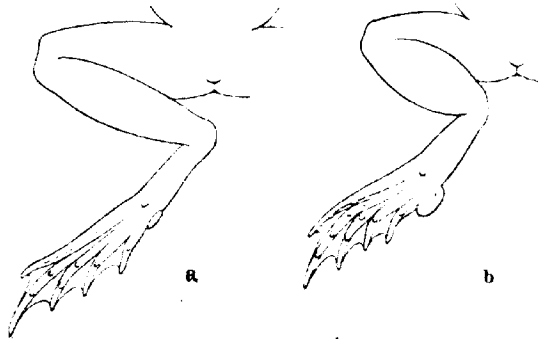
The head varies much in shape, and exceptionally may even be not unlike that of a typical *R. temporaria* (♀, var. *ridibunda*, from Crete). The cunthus rostralis is always very obtuse; I have never seen a specimen in which it may be said to be "strongly marked," as stated by Bolkay in his description of *R. chinensis*.

#### The Hind Limb.

That there are very considerable differences in the proportions of the hind limb, I was the first to point out, and I have proposed to make use of these for defining varieties, with the necessary restrictions in the diagnoses imposed by

the many exceptions. The following figure shows how striking these differences between the extremes are :—

Fig. 4.



Hind limbs of var. *ridibunda*, ♀ from Astrakhan (a), and var. *lessonae*, ♀ from Stow Bedon, Norfolk (b). ♂ nat. size.

These differences reside in the length of the tibia compared to that of the head and body, to that of the thigh (causing the heels to overlap, to meet, or to fail to meet when the limb is folded at right angles to the body), and to that of the foot; also in the size and shape of the inner metatarsal tubercle, its basal length being compared to the length of the inner toe (measured from the base of the tubercle). There is another character, not made use of before, derived from the thickness of the crural or tibial part of the limb: this varies, like other characters, within certain limits, according to the actual length of the bone and the degree of plumpness of the individual, but, comparing extreme forms, it will be found that the length of the tibia is usually over 3 times its width in the var. *ridibunda* and under 3 times in the var. *lessonae*.

When a large material is carefully examined, it is found, however, that these differences break down for the sharp definition of the various forms; there is considerable overlap between one form and the one next to it in the series, when the measurements are tabulated, thus precluding rigid definitions :—

	1.	2.	3.	4.	5.
<i>V. ridibunda</i> ..	3-4	1½-2½	1-1½	9-14	2½-4
<i>V. saharica</i> ....	2½-3	2½-2¾	1-1½	9-13	2½-4½
<i>F. typica</i> .....	3-4	1½-2½	1½-1¾	7-10	2-3
<i>V. lessonae</i> .....	2½-3	2¼-2¾	1½-1¾	5-8	1-2
<i>V. chinensis</i> ....	2½-3½	2-2½	1½-1¾	5-8	1-1½

1. Width of tibia in length.—2. Length of tibia in length from snout to vent.—3. Length of tibia in length of foot (measured from tarso-metatarsal articulation).—4. Length of metatarsal tubercle in length of tibia.—5. Length of metatarsal tubercle in length of inner toe.

Bolkay gives the following characters for distinguishing his three species:—

*R. esculenta*. Heels never meet; tibio-tarsal articulation reaches space between tympanum and posterior corner of eye (♀), or, at the utmost, space between anterior corner of eye and nostril (♂); inner metatarsal tubercle large, compressed, projecting, always longer than distance between it and subarticular tubercle of first toe.

*R. ridibunda*. Heels always overlap; tibio-tarsal joint just reaches back corner of eye (♀), or end of snout (♂); inner metatarsal tubercle small, of flattish cylindrical form, not very projecting, always shorter than space between it and subarticular tubercle of first toe.

*R. chinensis*. Heels never meet; tibio-tarsal joint reaches posterior corner of eye or as far as space between anterior corner of eye and nostril; inner metatarsal tubercle very large, projecting, compressed, hard and sharp, always a good deal longer than its distance from subarticular tubercle of first toe, frequently equal to length of first toe.

The proportion of the tibia to the thigh, expressed by the meeting or otherwise of the heels, is most useful for distinguishing the races, but it varies like most other characters, and we must not shut our eyes to exceptions to the rule. To take *R. ridibunda* as an example, I now find that the overlapping of the tibiae is not so constant as I formerly believed. Exceptions have already been noticed by Méhely\* in specimens from Southern Hungary, and I find the character to break down in 4 out of 13 examples from Angora and in 3 from Damascus which have lately been submitted to me by M. H. Gadeau de Kerville; besides, I am now convinced that the var. *susana*, proposed by me for specimens from Persia†, in which the tibiae simply meet,

\* Zichy's Zool. Forschungen, p. 61 (1901).

† Ann. & Mag. N. H. (7) xvi. 1905, p. 552.

does not deserve to stand. These exceptions, occurring in Asia, cannot be disposed of by an appeal to hybridity, as in the case of critical specimens from Germany and Austria. Hungary, where the var. *ridibunda* occurs side by side with the typical form, which fact would render such an assumption legitimate. From what I have myself observed in the Spreewald lakes near Berlin, I have no doubt the two forms cross in exceptional cases, notwithstanding the asynonymy which maintains their segregation when living together, but we have no practical means of discriminating between such mongrels and truly annectant specimens.

I may mention that the tibize freely overlap in one specimen of the typical form from Warsaw and in another from Mestre. As regards the *R. chinensis*, I am greatly surprised at Bolkay's statement, which is contrary to the descriptions by myself and by Wolterstorff\*, although supported by the description of one specimen by Stejneger†; the two first authors agree as to the heels meeting, Wolterstorff even adding that they sometimes slightly overlap; the only specimens in which I find the heels not to meet are from Kobe, Japan (two), and Pekin (6 out of 26), and they must be regarded as exceptions to the rule.

Although the hind limb is often shorter in the female than in the male, this is by no means generally the case; I can show 10 out of female specimens of the var. *ridibunda* from Central and Eastern Europe and Asia in which the tibio-tarsal articulation reaches beyond the eye, and even one, from Alemtojo, Portugal, in which it extends to the tip of the snout—that is, farther than in most males; in a male from Cornuna it reaches the eye, whilst in a female of identical size and locality it reaches between the eye and the nostril.

Bolkay's way of expressing the length of the inner metatarsal tubercle as compared to the inner toe originates from me, with certain reservations, however‡, but I have abandoned it long ago, having found many specimens of the typical form in which the tubercle is not longer than its distance from the subarticular tubercle of the first toe, whilst, on the other hand, it may be as long in specimens of the var. *ridibunda*.

It has been pointed out by Bedriaga§, Wolterstorff, and Bolkay that the usually highly developed, shovel-shaped

\* Abh. Mus. Magdeb. i. 1900, p. 140.

† Herp. Japan, p. 97 (1907).

‡ Proc. Zool. Soc. 1885, p. 608.

§ Wiss. Res. Przewalski Exped., Zool. iii. i. p. 15 (1893).

inner metatarsal tubercle of the var. *chinensis* is remarkable for a certain mobility, the distal part of its base being more or less detached from the metatarsal of the inner toe with which it is connected by a web-like membrane. This character is not only inconstant in this variety, as I was able to demonstrate to the second author by sending him for identification a cut-off foot of a specimen from Broughton Bay, Corea, which he returned to me named var. *lessone*, but it is also found in some specimens of the latter (from Cambridgeshire and Norfolk) when the tubercle is very strongly developed, a fact also observed by Fejervary \* in the case of his var. *bolkayi* from Switzerland (= *lessone*). This character is correlative of the transformation of the tubercle into a fossorial organ, as already recognised by Wolterstorff, who fully admits the true state of things in the var. *chinensis*, from a diagnostic point of view, although unfortunately not acquainted with the amount of variation in the var. *lessone*. It has also been observed that the base of the tubercle of the var. *chinensis* does not run parallel to the axis of the longest toe, but is oblique to it; this is however only more or less so in the Chinese-Japanese frog, again in relation with the degree of development of the tubercle, and a similar disposition, varying in degree, is likewise to be observed in the var. *lessone*.

Although the metatarsal tubercle may be identical in the two varieties, I quite agree with Wolterstorff, and have always held the view that the var. *chinensis* cannot have been derived from the var. *lessone*, the two forms representing independent extremes in the parallel evolution of the same adaptive character; but the var. *lessone* is there to illustrate the steps through which the character has been evolved out of a type such as the var. *ridibunda*, now so completely separated from the easternmost form of *R. esculata*. Wolterstorff seems to look upon the typical form, or rather its hypothetical direct ancestor, as the origin of the races in question; Bolkay, in my opinion, is nearer the truth when he suggests *R. ridibunda* being nearer to *R. chinensis*, but at the same time he inverts the drift of evolution in regarding the former as derived from the latter, owing to theoretical considerations based on the now exploded "praepollex" and "præhallux" theory.

In his description of *R. nigromaculata* (*chinensis*), Stejneger says the toes are about  $\frac{1}{2}$  webbed. It is so in some cases, but rather the exception than the rule, and similar

\* Beitr. Herp. Rhônetal, p. 20 (1909).

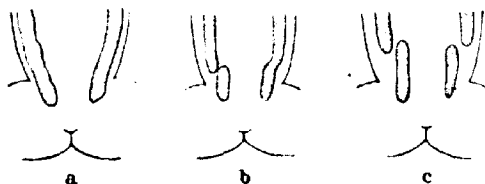
exceptions occasionally occur in the typical form (Poitiers, Bologna) and in the var. *ridibunda* (Alemtejo, Majorca, Rahanna in Morocco). The outer metatarsals are separated nearly to the base in *R. esculenta*, only in their distal half in *R. temporaria* and *R. arvalis*, the other European species filling up the gap between the two extremes.

#### *Integument and Markings.*

The elongate glandules or interrupted longitudinal glandular folds on the back\*, afford, generally speaking, a good distinctive character for the var. *chinensis*, but they may be very feebly marked or almost obsolete in some specimens (Kiu Kiang, Yokohama), and they are occasionally fore-shadowed in the var. *ridibunda* (Beit Jenn, near Damascus), so that the two forms are completely connected in this respect.

I may point out another character, hitherto overlooked, which affords an absolutely constant distinction between the typical form and the var. *chinensis*.

Fig. 5.



Posterior extremities of dorso-lateral folds in specimens from Berlin, var. *ridibunda* (a), Cadillac, var. *ridibunda* (b), and Vienna, f. *typica* (c).

In the former, and also in the var. *lessoneri*, the glandular dorso-lateral fold ends abruptly at some distance in front of the thigh, and it is often followed by a detached portion parallel with it but nearer to the mid-dorsal line and extending on the base of the thigh. In the var. *chinensis* the fold extends uninterrupted to the hip, or, if broken up posteriorly, without any deviation from the straight line. Now, this striking difference is completely bridged over when we take the var. *ridibunda*, as well as the var. *saharica*, into consideration. Some specimens have the fold continuous and

\* A very variable feature in the American representative of *R. esculenta*, *R. hallowellii*, L.

extending to the hip (fig. 5, n), others have a detached posterior part as in the typical form (c), whilst others again (b) connect the two conditions, the posterior part of the fold, though deviating, being confluent with the anterior and forming a bend before reaching the thigh.

Bolkay mentions among the specific differences between *R. esculenta*, *R. ridibunda*, and *R. chinensis*, that the dorso-lateral fold is wider (as wide as the upper eyelid) in the second than in the two others. This character is absolutely worthless, for in specimens of the typical form from France and Switzerland its width usually measures  $\frac{1}{2}$  to  $\frac{2}{3}$  that of the upper eyelid, but may be equal to it (St. Malo, Havre, Basle, Zofingen), and in German and Austro-Hungarian specimens of the var. *ridibunda*  $\frac{1}{2}$  to  $\frac{2}{3}$  that width is by no means unfrequent. The fold is always narrower than the upper eyelid in the vars. *chinensis* and *lessone*.

In my previous descriptions of the var. *ridibunda* I have drawn attention to the fact that the dorso-lateral fold, though usually broader than in the other forms, is less prominent; I should add that it is sometimes so flat that it cannot be traced without the use of a lens, when the pores with which it is studded indicate its course. It has not been pointed out however that these folds are rendered more inconspicuous still owing to the spots on the body being disposed quite irrespective of them, whilst in the typical form and the vars. *lessone* and *chinensis* they stand out on account of their lighter colour, hardly ever encroached upon by the spots, which may be arranged more or less in relation to them, especially when forming longitudinal bands. When a specimen of the var. *ridibunda* is seen at a short distance there is usually nothing to reveal the presence of the dorso-lateral folds, which strike the eye in the typical form and the vars. *lessone* and *chinensis*.

These facts have a bearing on the question of the derivation of the forms which constitute the species *R. esculenta*, and confirm the view I have held ever since I took up the study of the subject that the var. *ridibunda* is the most primitive form, out of which the others have been evolved. In a paper recently published\* on the derivation of characters in the genus *Rana* as a whole, the absence of the dorso-lateral fold is considered by me as the primitive condition, and the North American *R. catesbeiana*, in which it is totally absent, is, for this and other reasons, regarded as nearest the hypothetical prototype among all the species of Eurasia and

\* Bull. Soc. Zool. France, 1918, p. 111.



America. Close to *R. catesbiana*, there is another North American species, *R. septentrionalis*, in my opinion derived from it, in which the fold is either present or absent, according to individuals, but when present is short and very flat, with the spots and marblings irregularly distributed over the body. Such a type leads to the state of things in *R. esculenta*, var. *ridibunda*.

Bolkay alludes to the transverse expansion of the dark spots on the back as an important character of *R. chinensis*, but such transverse markings are by no means the rule in this variety, some specimens of which are, on the contrary, longitudinally streaked, as is often the case in the typical form and the var. *lessone*, but never in the vars. *ridibunda* and *saharica*. I may here mention that specimens with the black markings forming cross-bars on the back are exceptionally met with, not only in the var. *ridibunda*, but also in the typical form (females from Rivoli and Verona).

The light vertebral streak or band is very frequent in the typical form and the vars. *lessone* and *chinensis*, less so in the var. *ridibunda*, in which it is generally broader, and usually absent in the var. *saharica*. I do not think this light vertebral streak, which occurs in so many species, is to be looked upon as a primitive character; the frequent cases of deviation of its course from the straight line (most strongly marked in specimens from Calcinaro and Cadillac) suggest a different interpretation, and, in the present state of our knowledge, its signification is highly problematic, as is that of a light line along the inner side of the upper surface of the leg which, in many Oriental and African species, often accompanies the vertebral streak, and exceptionally occurs in *R. esculenta*, var. *chinensis* (♂ from Japan). Both streaks are absent in all American species, with the single exception of *R. cantabrigensis*, Baird, the representative of the European *R. arvalis*, Nilss.

#### The Skull.

The osteological characters appealed to by Bolkay are evidently derived from an examination of a very small number of specimens; put to the test of a larger material they prove to be worthless for defining species.

I am especially surprised at his statements concerning the nasal and fronto-parietal bones. Although usually in contact with each other in full-grown specimens of the typical form, as described and figured by Ecker, Fatio, and others.

the nasal bones are not always so; there are frequent exceptions, as my own description implies\*, but such exceptions occur as well in the var. *ridibunda*, even in large specimens (♀ from Vienna, 90 mm. from snout to vent, ♀ from Prague, 120 mm.), and I have come across adults of the var. *chinensis* in which the nasal bones are completely separated from each other, as is usually the case in immature or small specimens of all the forms. As to the presence or absence of the anterior notch between the frontoparietals, this is a mere individual peculiarity, usually dependent on the size of the specimen; yet I wish to draw attention to the figures given by Camerano† of small specimens of the var. *lessona* from Italy in which the anterior extremity of the frontoparietals answers to Bolksay's definition of *R. chinensis*.

#### The Size.

I append the measurements, from snout to vent, of the largest specimens of the different forms in the British Museum. According to Werner‡, the var. *ridibunda* may reach a length of nearly 150 mm. in Austria.

	♂.	♀.
Var. <i>ridibunda</i> .....	95 mm.	125 mm.
Var. <i>saharica</i> .....	58	80
F. <i>typica</i> .....	78	95
Var. <i>lessona</i> .....	64	78
Var. <i>chinensis</i> .....	70	85

#### The Tadpole.

I have examined large series of tadpoles of the vars. *ridibunda* and *chinensis* without succeeding in finding any characters by which to distinguish them from those of the typical form. The characters pointed out by Annandale§ for the var. *chinensis* are not confirmed as regards the mouth-disc, the position of the spiraculum, or the length of the tail compared to that of the body.

#### Conclusions.

When dealing with polymorphic species, botanists often distinguish between forms (species, some term them) of first, second, third, and fourth rank. Applying this concept to *Rana esculenta*, the typical form representing of course the

\* Taill. Batr. Eur. p. 279.

† Mem. Acc. Torin. (2) xxxv. 1883, p. 60.

‡ Rept. Amph. (Osterr.-Ung. p. 88 (1897).

§ Mem. As. Soc. Beng. vi. 1917, p. 147.

first grade, we may place the var. *chinensis* in the second, the var. *ridibunda* in the third, and the vars. *saharica* and *lessonæ* in the fourth. Looking at things from a practical standpoint, we must regard the var. *saharica* as but a slight modification, a geographical race distinguishable from its nearest neighbour but impossible to define if specimens from the whole range of distribution of the var. *ridibunda* are taken into consideration. The typical form is completely connected with the var. *ridibunda*, and where the two co-exist in a locality, annectant individuals may be regarded as the result of crossing, such as undoubtedly must take place; but this explanation fails when we have to deal with specimens from France, S.E. Europe, and Asia, where individuals of uncertain identification likewise occur, although the discrimination of the two forms is in most cases quite easy. It is no longer so when we come to the typical form compared with the var. *lessonæ*, and in this case the naming of certain specimens is perfectly arbitrary, as those who have had to deal with a considerable material from places where the two forms co-exist fully admit\*; yet, the extreme, what some would call the "pure *lessonæ*," such as it occurred in the Cambridge fens and is still found in a very few localities in Norfolk, is well entitled to varietal rank, its structural characters being fixed and so considerable in degree when compared with the typical form that it would undoubtedly be looked upon by many as a species were we not acquainted with the annectant examples from the Continent. These extreme specimens of the var. *lessonæ* represent the terminus of an uninterrupted series starting from the var. *ridibunda* and passing through what is called the typical form.

Another terminus form, in which the principal characters of the var. *lessonæ* are repeated, is the var. *chinensis*, which in all probability is also derived from the var. *ridibunda*, but the connecting-links of which have disappeared or are still unknown. If we appeal to the existence of a hiatus between forms as a sole criterion for deciding on what is a species, then *R. chinensis* is entitled to stand as such; however, considering the many points of agreement, and preferring to keep an eye on resemblances rather than on differences, the rank of variety or subspecies appears to me the more appropriate for this form, as it did to Lacaze many years ago†. Owing to the state of things in the

\* Cf. Wolterstorff, *Schr. Nat. Ges. Danzig*, (2) xi. 1904, p. 46.

† *Bull. Soc. Zool. France*, 1880, p. 61. "Cette forme, que quelques auteurs regardent comme une espèce distincte, d'autres comme une

European forms, the course I have followed is surely the better from a philosophical point of view, whilst the use of a varietal designation precludes all fear of the distinction being overlooked.

The following diagram expresses the relationship between the five forms, as I conceive them :—



We cannot yet apply the test of crossing experiments in justification of the subordinate position assigned to *R. chinensis*, as Pflüger was able to do in the case of *R. esculenta* and its var. *ridibunda*, but another physiological argument has been put forward by Wolterstorff: the large and often sharp-edged metatarsal tubercle of *R. chinensis* is an adaptation to burrowing habits unlike those of *R. esculenta*. We are told that Dr. Kröyenberg observed the Chinese frog to dig and retire deep into the ground of dried-up rice-fields, and this habit is regarded as an important ethological differentiation from its European representatives. Curiously, however, Fejervary very shortly after redescribed the var. *lessonae* under the name of var. *bulkayi*, from specimens living in marshes at the mouth of the Rhône in Switzerland, and observed the behaviour of this frog on land to be different from that of the typical *R. esculenta*, the large and somewhat movable metatarsal tubercle being used to burrow in the ground after the manner of *Pelobates*. It is interesting to note, in this connection, that Wolterstorff, who (1906) seemed to attach so great an importance to this peculiarity in the case of the Chinese frog, had (1904) only reluctantly recognised *R. lessonae*'s rank as a variety, a term which for him expresses mere individual variations, such as his colour-

simple variété de *Rana esculenta*, L., a des caractères propres et constants qui lui méritent une description particulière et un nom spécial; elle me semble cependant assez voisine de *Rana esculenta* pour que je croie utile de ne l'en point séparer spécifiquement . . . . Et si, après quelques hésitations, je me décide à classer [*R. chinensis*] comme sous-espèce de *R. esculenta*, c'est par cette seule considération qu'elle me paraît beaucoup plus voisine de cette dernière que de toutes les autres grenouilles.

varieties *striata* and *nigromaculata* in *R. arvalis*\*, and refused to admit it as a subspecies.

These observations on the fossorial habits of the vars, *chinensis* and *lessone* should be borne in mind by those who appeal to the behaviour of the Indian *R. crassa*, compared to that of the typical *R. tigrina*, as an argument in favour of its specific distinction †. These supposed species offer a perfect parallel to the lines of evolution which can be traced in *R. esculenta*, as I have recently pointed out ‡.

Although we must not expect to find among the species of the present day the actual types out of which their allies have been evolved, yet I think it legitimate speculation to look upon certain species, or certain small groups of species, as a sufficiently near approximation to help us towards an elucidation of the phylogenetic relationships, the expression of which should be the aim of taxonomy. In this sense, and with this reservation, I consider *R. catesbeiani*, Shaw, and *R. gryllio*, Stejn., as representing the most primitive forms of America and Eurasia; the species that cluster round them, *R. septentrionalis*, Baird, *R. clamitans*, Daud., *R. onca*, Cope, *R. virgatipes*, Cope, *R. montezumae*, Baird, would be derived from the same stock; they constitute a distinct section, which is perfectly natural, though not susceptible of a very strict definition. From this section we may imagine the one of which *R. esculenta* is the type to have been derived, and there is little doubt in my mind that the Chinese *R. planigi*, Lataste, is a connecting form, nearly allied to, but in most respects less modified than, *R. esculenta*, both having been evolved out of the same ancestor, possibly related to the Oligocene-Miocene *R. meriani*, H. von Mey. The chief distinctive features of *R. esculenta* compared to *R. planigi* reside in a reduction of the nasal bones, the more obtuse fingers, and the very peculiar external vocal sacs. By what steps this last

\* Such modifications represent varieties only in the sense taken by horticulturists, and should not be given names in scientific nomenclature. Eliminating these cases, I apply the term *varietas* to every division of the system subordinate to the species, without any further consideration of hierarchy, in order to avoid complicating nomenclature by the use of tri-, quadri-, or even quinquenominale. In so doing, I simply adhere to the Linnean method which has so long been followed, and is still used by most of the botanists for whose work I have the greatest respect. "Les variétés des systématistes sérieux sont les espèces de M. Jordan, au moins du Jordan des *Observations et du Puyillus* . . . . Le mot variété employé par les botanistes pour désigner une race sauvage laisse peut-être à désirer, mais il jouit de la priorité." J. Briquet, *Questions de Nomenclature*, Bull. Herb. Boissier, ii, 1894, p. 84.

† Annandale, *Rec. Ind. Mus.* xv, 1918, p. 63.

‡ *Rec. Ind. Mus.* xv, 1918, p. 61.

character was reached, *R. halecina*, L., is there to show us, for within the limits of this highly variable species, the vocal sacs may be said to be still in process of evolution; situated behind the commissure of the jaws, as in *R. esculenta*, *R. montezumæ*, *R. areolata*, B. & G., and *R. capito*, Leconte, but unlike those of all other frogs, they are either internal or external, showing every degree of development, and when external they form folds which, in certain individuals, have a tendency towards the invagination characteristic of the sacs in *R. esculenta*. We may well assume the direct ancestors of *R. esculenta* to have passed through such stages in the course of parallel evolution.

XXVIII.—Contributions to a further Knowledge of the  
Rhynchotal Family Lygæidæ. By W. L. DISTANT.

[Continued from p. 179.]

*Lygæus dregii*, sp. n.

Head, pronotum, scutellum, corium, and body beneath griseo-fuscous, two small central spots on pronotum, two larger spots on clavus, and two still larger spots on corium—one on each side of claval apex—black; basal third of lateral margin to corium, connexivum beneath, and legs pale testaceous or ochraceous; membrane pale fuscous, narrow base, lateral margins, and an irregular discal, transverse, angulated spot greyish white; antennæ ochraceous, the apical joint fuscous, second joint a little longest, third and fourth joints subequal in length; pronotum and scutellum centrally longitudinally carinate; the upper surface is more or less finely and obscurely very shortly pilose.

Long. 8 mm.

Hab. Abyssinia; Taddecha, Mullka (*Degen*).

*EXOPAMEKA*, gen. nov.

Head robust, about as long as broad: eyes projecting beyond the anterior angle of pronotum but not reaching its anterior margin; antennæ with the basal joint stoutest and considerably passing apex of head, second joint longest; rostrum with the basal joint not quite reaching base of head, its apex scarcely passing the anterior coxæ; pronotum

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elongate but very little longer than broad at base, lateral margins narrowly laminately carinate, anterior collar very narrow, subobsolete, anterior much longer than posterior lobe, convex, its lateral margins rounded, lateral margins of the posterior lobe obliquely straight; scutellum longer than broad, subtriangular; anterior femora thickened, spined beneath, anterior tibiæ distinctly curved, their apices dilated and inwardly a little angulate, intermediate and posterior tibiæ moderately spinulose.

Type, *E. ethiopica*, Dist.

Allied to *Pseudopamera*, Dist., from Central America.

*Exopamera ethiopica*, sp. n.

Head black, moderately shortly palely pilose; eyes darker black; ocelli purplish red; pronotum ochraceous, the lateral and anterior margins and the posterior lobe paler in hue, punctate, especially the posterior lobe, the basal margin and lateral basal angles more or less shining black; scutellum ochraceous, basal and apical areas black, more or less coarsely punctate; corium ochraceous, clavus more or less closely blackly punctate, two prominent spots before claval area, an irregular transverse subapical spot, and the apical angle shining black, the whole corium more or less coarsely punctate; membrane black, its apical margin pale fuliginous; head and abdomen beneath opaque black; sternum shining black and coarsely punctate; coxæ, trochanters and legs, narrow lateral sternal margins and posterior sternal segmental margins ochraceous; rostrum ochraceous; membrane moderately passing the abdominal apex; antennæ with the first, second, and third joints ochraceous, their apices black, fourth joint greyish white, its apical half black, second joint longest, third and fourth joints almost subequal in length.

Long. 9–10 mm.

Hab. Brit. E. Africa; Kibwesi (S. A. Neave).

*Exopamera mirabilis*.

*Aphanus mirabilis*, Dist. Ann. Mag. Nat. Hist. (7) xii. p. 471 (1903).

Hab. Fernando Po.

ALHANYARIA, gen. nov.

Body elongate; head subtriangular, apical area distinctly narrowed and apex of central lobe distinctly prominent;

eyes moderately prominent and slightly passing the anterior angles of the pronotum; antennæ moderately robust, basal joint only a little passing apex of head; rostrum with the basal joint almost reaching base of head; pronotum a little longer than broad at base, and transversely constricted near base; corium extending only to about three-fourths of the abdomen; membrane absent; anterior femora incrassated and finely spined beneath; anterior tibiæ a little curved but not centrally spined; scutellum elongate, longer than broad.

Allied to *Fontejus*, Stål, but the pronotum much shorter, anterior tibiæ not centrally spined, &c.

*Albanyaria multicolorata*, sp. n.

Head, anterior lobe of pronotum, and the scutellum black; the narrow posterior pronotal lobe and the extreme apex of scutellum greyish white; antennæ ochraceous, apex of third joint and more than apical half of fourth black; corium ochraceous, the lateral marginal areas with three prominent black spots, the smaller near base, the largest near middle, and the third at apex, the exposed apical area of the abdomen black; body beneath black; posterior sternal segmental margins very pale ochraceous; legs reddish ochraceous, apical halves of the anterior femora and apices of the tibiæ and tarsi black; antennæ with the second joint slightly longer than the third and about subequal with the fourth; scutellum more or less rugosely punctate; clavus linearly somewhat coarsely punctate; rostrum ochraceous, the basal joint black, remaining joints imperfectly seen in carded type.

Long.  $5\frac{1}{2}$  mm.

Hab. W. Australia; Albany (*J. J. Walker*).

GENUS LARYNGODUS.

*Laryngodus*, Herr.-Schæff. Wanz. Ins. ix. pp. 191, 212 (1853).

The short description given by Herrich Schæffer and some imperfections in the figure given of the type of the genus render a fuller description of both necessary.

*Laryngodus australis*, Herr.-Schæff. Wanz. Ins. ix. p. 212, fig. 967 (1853).

Head fuscous brown; eyes black; antennæ dark castaneous, apices of the first, second, and third joints very



narrowly black, fourth joint ochraceous with nearly apical third black; head and anterior lobe of pronotum fuscous brown, posterior pronotal lobe black, with two central spots and the lateral margins creamy white or very pale ochraceous; eyes black; scutellum fuscous brown; corium dull ochraceous, darkly punctate, inner area of clavus more densely darkly punctate, disk of corium with an oblique longitudinal fascia—neither reaching base nor apex, a sub-central, transverse, very irregular fascia, and the apical angle, black; membrane fuscous, the veins, and some irregular suffusions and spots, pale dull ochraceous; body beneath and legs dark castaneous, basal spine to antennæ beneath, anterior margin of prosternum, coxæ, posterior angles of meso- and meta-sterna, and the greater part of basal joints of intermediate and posterior tarsi pale ochraceous.

Head elongate, longer than basal breadth including eyes, narrowed on apical area, and with a short spine at base of antennæ; eyes prominent, almost reaching base of head; antennæ with the basal joint shortest and stoutest, second joint a little longer than third, which is again longer than fourth; pronotum punctate, with anterior lobe much narrower, more globose, and about twice as long as the posterior lobe which is more strongly punctate, anterior lobe with a central, longitudinal, fasciate, flat impression; scutellum about as broad as long, subtriangular, thickly punctate, extreme apex ochraceous; corium broadened on apical area; membrane with the venation very prominent; anterior femora strongly thickened, narrowed at base and apex, distinctly spined beneath; anterior tibiæ flattened and sub-spinosely dilated at apices; rostrum about reaching the intermediate coxæ.

Long. 10 mm.

Hab. S.W. Australia; Yallingup (R. E. Turner).

*Bosbequius australis*, sp. n.

Head, anterior area of pronotum, scutellum and sternum, black or blackish; anterior margin and posterior area of pronotum and corium brownish ochraceous; lateral pronotal margins and a spot near inner angle of apical margin to corium very pale luteous; abdomen beneath brownish ochraceous; femora castaneous, their apices and the tibiae and tarsi ochraceous; antennæ dull ochraceous, second joint longest, first joint slightly passing apex of head\*; head

\* In the typical Oriental species the basal antennal joint did not reach the apex of head.

(including eyes) narrower than anterior margin of pronotum ; first joint of rostrum extending beyond base of head ; posterior area of pronotum, scutellum and corium coarsely punctate ; anterior femora strongly incrassate.

Long. 8 mm.

*Hab.* Australia ; Adelaide River (*J. J. Walker*).

The type of the genus *Bosbeugius* was from Tenasserim (Faun. Brit. Ind., Rhynch. ii. p. 65, fig. 1).

*Thebanus nigrinus*, sp. n.

Dull ochraceous ; head, anterior lobe of pronotum, and anterior area of scutellum black ; head beneath and sternum black ; legs ochraceous ; abdomen beneath dark slaty-grey ; antennae ochraceous, second joint a little longest, third and fourth almost subequal in length ; pronotum thickly, somewhat coarsely punctate ; scutellum punctate, black before the anterior branches of the cruciform carination, and dull ochraceous behind them ; posterior margin of pronotum concave before scutellum ; corium (excluding lateral marginal areas) darkly punctate ; membrane slaty-grey, slightly passing the abdominal apex.

Long.  $3\frac{1}{2}$  mm.

*Hab.* Burma ; Karennee.

Genus LACHNOPHOROIDES.

*Lachnophoroides*, Dist. 'Nova Caledonia,' Zool. i. p. 381 (1914).

Type, *L. ornatipennis*, from New Caledonia (ibid. pl. xi. fig. 9 ♀).

I am now able to amplify the description of this genus by sexual characters, having only seen a single ♀ specimen previously.

♂. Pronotum distinctly longer than breadth at base ; anterior tibiae strongly sinuately curved and armed with a short robust spine near middle of under surface.

♀. Pronotum about as long as broad at base ; anterior tibiae unarmed.

*Lachnophoroides crudelis*.

*Pachymerus crudelis*, Hagl. Öfv. Vet.-Akad. Forh. 1895. p. 462.

*Hab.* W. Africa ; Gaboon (fide *Haglund*). Lagos ; Onitsha (*A. B. S. Powell*). N.E. Rhodesia ; Upper Luangwa R. (*S. A. Neave*). Uganda Protect. between Junja and Busia, E. Busoga (*S. A. Neave*). Abyssinia (Lake Rudolph Exped.—*Ph. C. Zaphiro*).

*Lachnophoroides rudolfianus*, sp. n.

Head and anterior lobe of pronotum dull, dark ochraceous, posterior pronotal lobe paler ochraceous with darker punctures in somewhat transverse series and with three central longitudinal darker series, lateral margins broadly and basal margin narrowly pale ochraceous, a black spot near each basal angle; scutellum ochraceous, darkly punctate, a large castaneous spot at base and two linear black spots on apical area; corium very pale ochraceous, more or less darkly punctate, clavus with a black and greyish spot at base, beyond middle of corium a broad transverse dark castaneous fascia and the apical margin narrowly and irregularly of the same colour; membrane pale shining ochraceous; head beneath and sternum piceous; abdomen beneath dull dark testaceous; legs and rostrum ochraceous; antennæ ochraceous, apices of the second and third joints and apical half of the fourth black, second joint a little longest, third and fourth joints subequal in length; anterior femora robust, strongly spined beneath near apex, anterior tibiæ in ♂ strongly curved, and with a prominent spine beneath near middle.

Long. 8 mm.

*Hab.* Soudan; Kaig (Lake Rudolph Exped.—C. Singer).

*Aphanus littoralis*, sp. n.

Head black or very dark castaneous, eyes griseo-fuscous; antennæ dull ochraceous, apices of first, second, and third joints more or less fuscous, fourth joint dark fuscous with a broad subbasal greyish annulation; pronotum ochraceous, prominently brownly punctate, the lateral margins almost impunctate, anterior half (excluding margins) dark castaneous and almost impunctate, with a small central pale ochraceous spot at anterior margin; scutellum ochraceous, prominently brownly punctate, the basal area black; corium ochraceous, rather finely brownly punctate, extreme lateral margins almost impunctate; membrane brownish ochraceous with somewhat paler mottlings; body beneath castaneous, the lateral margins, posterior sternal segmental margins, rostrum, and legs ochraceous, the lateral abdominal margin with large castaneous spots; second, third, and fourth joints of antennæ gradually decreasing in length, the second a little longest; first joint of rostrum about reaching base of head; membrane about reaching abdominal apex; pronotum with a more or less distinct central

longitudinal narrow carination; scutellum a little foveately depressed at base.

Long.  $8\frac{1}{2}$ –10 mm.

*Hab.* Blue Nile (*E. S. Cressin*), nr. mouth of Dinder R. and Roseires (*S. S. Flower*). N.W. shore of L. Nyasa, from Florence Bay to Karonga (*S. A. Neave*).

*Aphanus ferrugineus*, sp. n.

Head black; antennæ with the basal joint black, second and third joints ferruginous; pronotum pale ferruginous, coarsely darkly punctate, the anterior area (excluding margins) black; scutellum black, coarsely darkly punctate, becoming paler and more ferruginous on apical area, and with an ochraceous spot on each lateral margin near base; corium brownish ochraceous, darkly punctate, with two small obscure black spots in oblique series on apical half, the lateral margins narrowly impunctate; body beneath black, the posterior sternal segmental margins, rostrum, and legs ferruginous; second joint of antennæ considerably longer than third; apex of central lobe of head distinctly prominent; in some specimens the femora are distinctly darker—almost black—than the tibiae; basal joint of rostrum passing base of head; membrane, a little paler than corium, reaching abdominal apex.

Long. 8– $8\frac{1}{2}$  mm.

*Hab.* Nyasaland (*Cotterell*); W. shore of L. Nyasa between Domira Bay and Kotakota (*S. A. Neave*). N.E. Rhodesia; Mid-Luangwa Valley (*S. A. Neave*).

*Aphanus apicalis*.

*Rhyparochromus apicalis*, Dall. List Hem. ii. p. 562 (1852).

*Rhyparochromus turgidifemur*, Stål, Öfv. Vet.-Ak. Forh. 1855, p. 32, 1.

*Rhyparochromus nigromaculatus*, Stål, Öfv. Vet.-Ak. Forh. 1855, p. 32, 2.

*Locusts apicalis*, Stål, Hem. Afr. ii. p. 165 (1865).

*Aphanus erasus*, Dist. Ann. & Mag. Nat. Hist. (7) viii. p. 501 (1901).

In describing my *A. erasus* I wrote, "Allied to *A. apicalis*, Dall., differing by the exceedingly coarse punctuation on the lateral margins of the pronotum and corium, &c." Compared with the type of Dallas, that held good at the time of writing, but since then a large number of species have reached the British Museum, and intermediate varieties occur.

*Hab.* S. Africa (Brit. Mus.). Ovampo L. (*Eriksson*).

Transvaal; Pretoria (*Distant*), Lydenburg (*Krantz*). N.E. Rhodesia; Mid-Luangwa Valley (*Neave*). Blue Nile; Roseires (*Flower*). Congo (*Richardson*).

*Aphanus albiger*, sp. n.

Head and anterior area of pronotum black, posterior pronotal area ochraceous, brownly punctate, and at the lateral marginal junctions of these two areas a somewhat large pale ochraceous spot; scutellum black; corium ochraceous, thickly darkly punctate, extreme lateral margin impunctate, inner claval margin for about half its length from base pale ochraceous and impunctate, from thence to apex very thickly blackly punctate, a short elongate black line near outer claval margin, followed by a large black spot near and outside claval apex, the apical margin of corium narrowly black, the two last markings separated by a small pale impunctate spot; membrane brownish with the venation somewhat paler in hue; body beneath, rostrum, and legs black, coxal spots and narrow, irregular posterior margins to sternal segments pale ochraceous; antennae with the third joint shortest, second and fourth subequal in length.

Long. 6-6½ mm.

*Hab.* South Africa; Grahamstown. Natal; Durban (*F. Muir*).

Allied to *A. apicalis*, Dall., but a smaller and narrower species, markings of the pronotum and short third joint of antennae different.

*Aphanus nigrellus*, sp. n.

Head, antennae, pronotum, and scutellum black, lateral pronotal margins ochraceous; corium dull ochraceous, two short claval lines and the apical area black, the latter containing a prominent, central, transverse greyish-white spot, and the extreme apical angle also of that colour; membrane griseo-fuscous, with an apical white spot; body beneath, rostrum, and legs black; antennae somewhat robust, third joint a little shorter than second or fourth joints; pronotal lateral margins distinctly, somewhat longly pilose.

Long. 6 mm.

*Hab.* Nyasaland; between Ft. Mangoché and Chikala Boma (*S. A. Neave*).

Allied to both *A. apicalis*, Dall. and the preceding species here described—*A. albiger*, but differing by the colour of the pronotum and its longly pilose lateral margins, &c.

*MAXAPHANUS*, gen. nov.

Allied to *Aphanus*, Lap., from which it differs by the longer and more elongate body; the longer and more robust basal joint of the antennæ, which is as long as the head and projects considerably beyond its apex; anterior femora shortly spined beneath, with a long and very distinct spine before apex, anterior tibiæ also shortly spined beneath beyond base.

*Macaphanus africanus*, sp. n.

Dark castaneous, in some specimens almost piceous: lateral margins (excluding basal areas) of pronotum and sometimes a small central spot to same, corium with about basal half of lateral margin, a small lateral spot beyond it and nearer apex, a small discal spot outside the apical claval area and a minute spot before posterior margin, extreme apex of scutellum, rostrum and legs, ochraceous; apical areas of femora and the tibiæ and tarsi darker and more brunescent; antennæ dark castaneous, fourth joint (excluding apical area) pale ochraceous, second and third joints almost subequal in length and longest, fourth longer than first which considerably passes the apex of head; pronotum distinctly, broadly, transversely impressed near middle, the anterior area smooth, the posterior area finely wrinkled, lateral margins distinctly laminate; corium distinctly punctate; membrane pitchy-brown, the veins prominent, the two inner veins strongly curved at base.

Long. 13-14 mm.

*Hab.* Nyasaland; Mlanje (S. A. Neave). N. E. Rhodesia; Upper Luangwa R. (S. A. Neave). Uganda: Tero Forest (C. C. Gowdey), Entebbe (C. A. Wiggins).

*Metochus holsti*, sp. n.

Head, anterior lobe of pronotum, and scutellum black, posterior pronotal lobe piceous, darkly punctate, and with a pale central longitudinal line; corium ochraceous, clavus, a broad irregular transverse fascia connecting apex of clavus with lateral margin, and the apical margin black, the anterior area between the clavus and lateral margin is ochraceous, brownly punctate, the area between the transverse fascia and apex creamy-white; membrane fuscous with obscure paler mottlings; head beneath and sternum black; abdomen beneath dark castaneous, with some lateral

marginal ochraceous macular markings; rostrum ochraceous, basal and apical joints piceous; femora black, their bases and the whole of the tibiae and tarsi more or less ochraceous; antennae piceous, basal half of apical joint ochraceous, second joint longest, third and fourth almost subequal in length; anterior femora robust, shortly spinose beneath.

Long, 10 mm.

*Hab.* Japanese Archipelago; Tsushima Island (*P. Holst*).

*Dieuches yrelatus*, Dist. Ann. & Mag. Nat. Hist. (7) viii. p. 505 (1901).

*Hab.* Mashonaland; Umfili River (*G. A. K. Marshall*). Nyasaland; Valley of N. Rukuru, Karonga District (*S. A. Neave*). Uganda; Entebbe (*C. C. Gordey*). Abyssinia: Gibe River (*Ph. C. Zaphiro*).

The type was from Mashonaland.

*Dieuches parvipictus*, sp. n.

Head, pronotum, and scutellum black; anterior half of lateral margins and some small spots (usually two but sometimes four) on disk of pronotum, two spots near base and extreme apex of scutellum ochraceous; antennae ochraceous, apex of third joint black, more or less mutilated in the twelve specimens now before me; corium ochraceous, brownly punctate, extreme lateral margins pale and impunctate, a spot at base of clavus, a large spot near inner posterior angle, a very small spot in a line with it on lateral margin, and the apical margin black; body beneath black; rostrum and legs ochraceous, apex of rostrum and usually apical areas of the femora—more or less—black; antennae with the second and third joints almost subequal in length; scutellum with a more or less distinct, central, longitudinal carinate line.

Long, 7–8 mm.

*Hab.* Katanga; Kambove and Luffra River (*S. A. Neave*).

Allied to *D. patruelis*, Stål, but a smaller species with both the pronotal lobes black.

*Dieuches consimilis*, sp. n.

Allied to the preceding species in general markings and coloration, but a larger species with the basal joint and apices of the remaining antennal joints black; posterior pronotal lobe more strongly and coarsely punctate; scutellum

without the central carinate longitudinal line which is always more or less pronounced in *D. parvipictus*.

Long. 9-10 mm.

*Hab.* Uganda; Entebbe (C. C. Gowdey). Katanga; Kambove (S. A. Neave). Abyssinia (C. Singer).

*Dieuches smithi*, sp. n.

Head and anterior lobe of pronotum testaceous, posterior pronotal lobe ochraceous, thickly darkly punctate, lateral pronotal margins pale, impunctate; scutellum testaceous, extreme apex pale ochraceous; corium dark ochraceous or brownish ochraceous, lateral margins and a large irregular spot before apex pale ochraceous; membrane brownish ochraceous; body beneath testaceous; lateral margins of sternum, posterior margin of metasternum, and lateral abdominal margins ochraceous; rostrum and legs ochraceous, apical areas of femora and apices of the tibiae piceous; antennae ochraceous, the basal joint and apices of remaining joints dark testaceous or piceous, second and fourth joints longest and subequal in length; pronotum with a central longitudinal carinate line on posterior lobe; first joint of rostrum about reaching base of head; membrane not quite reaching abdominal apex in ♂, distinctly shorter in ♀.

Long. 10-11 mm.

*Hab.* S. Africa (Dr. Smith's Coll.). Graham's Town (F. Pym).

Allied to *D. umbrifer*, Stål.

*Dieuches sloggetti*, sp. n.

Black; lateral margins of pronotum and corium, second joint and base of third joint of antennae (fourth joint mutilated), tibiae and tarsi stramineous or pale ochraceous; second joint of antennae much longer than third; pronotum somewhat narrow and elongate, posterior lobe thickly punctate; corium and clavus more or less thickly punctate; first joint of rostrum about reaching base of head.

Long. 9 mm.

*Hab.* S. Africa; Deelfontein (Col. Sloggett).

METADIEUCHES, gen. nov.

Head robust, about as long as breadth between eyes, which almost reach anterior margin of pronotum or are not far removed from same, in front of eyes laterally strongly obliquely sinuate, the apex of the central lobe prominent;



antennæ with the basal joint moderately stoutest, slightly apically curved, shorter than second joint which again is a little shorter than third, fourth almost subequal in length to first: rostrum reaching the anterior coxæ; pronotum elongate, longer than breadth at base, lateral margins of anterior lobe slightly oblique, those of the posterior lobe more prominently oblique, the posterior angles submodulose, basal margin almost truncate, very slightly concave, anterior margin truncate; scutellum moderately long and slender, slightly longer than broad at base, lateral margins straightly oblique; legs elongate, anterior femora finely spined beneath, anterior tibiæ slightly dilated at apex; membrane passing abdominal apex.

Type, *M. dispar*, Hagl.

*Metadieuches dispar*.

*Dieuches dispar*, Hagl. Ofv. Vet.-Akad. Förh. 1895, p. 460.

*Hab.* Gaboon (*Sjöstedt*). Cameroons (*Escalera*). Uganda: Entebbe (*Dr. C. A. Wiggins and C. C. Gowdey*), Mweru, Kyanja, Mabira Forest, Katanga River (*C. C. Gowdey*), shores of L. Isolt or Wanala, 3800 ft., and S. of L. George (*S. A. Neave*).

*Poentius variegatus*, sp. n.

Head and anterior lobe of pronotum black; posterior lobe of pronotum dark castaneous and coarsely punctate, the anterior and posterior lobes separated by a transverse ochraceous fascia; scutellum black; corium ochraceous, a longitudinal fascia in clavus, and nearly the apical half of corium black, the latter containing a narrow transverse pale ochraceous fascia a little beyond its middle; membrane dull greyish; head beneath and rostrum dull, dark castaneous, posterior margin of metasternum more or less greyish white; abdomen beneath black; legs black, apices of anterior and intermediate femora and the anterior tibiæ ochraceous; (posterior legs mutilated in type); antennæ with the basal joint ochraceous, second and third joints black, second a little longer than third (fourth joint mutilated in type); head deflected, immersed to eyes, a little longer than broad; pronotum with a central longitudinal, ill-defined carinate line; scutellum a little longer than broad; rostrum about reaching the intermediate coxæ.

Long.  $6\frac{1}{2}$  mm.

*Hab.* Gaza Land; near Chirinda Forest (*G. A. K. Marshall*).

*Lethæus longirostris*.

*Lethæus longirostris*, Reut. Ent. Tidskr. viii. p. 102 (1887).

*Hab.* Madagascar (fide Reut.). Rodriguez (*Gullion*). Natal (*Bell-Marley*). N.E. Rhodesia; Lower Luangwa River, near Petauke, N.W. shore of L. Nyasa (*S. A. Neave*).

This species is variable in size; specimens now before me in length range between 9 and 12 mm.

*Lethæus descriptus*.

*Rhyparochromus descriptus*, Walk. Cat. Het. v. p. 103 (1872).

*Rhyparochromus alienus*, Walk. *ibid.* cit. p. 105.

*Lethæus signatus*, Dist. Ann. & Mag. Nat. Hist. (7) viii. p. 506 (1901).

*Lethæus descriptus*, Dist. Faun. Brit. Ind., Rhynch. ii. p. 89 (1904).

*Hab.* N. India. Ceylon. Tenasserim. North Borneo. Sula Island. Natal; Durban (*Bell-Marley*). N.E. Rhodesia; Upper Luangwa River (*S. A. Neave*).

We are now able to record the distribution of this species (previously only known from the Indian and Malayan regions) to the southern Ethiopian habitats of Natal and Rhodesia.

Bergroth (Phil. Journ. Sci. xiii. p. 95 (1918)) has devoted nearly three large octavo pages to the description of a species from the Philippine Islands (*L. robustus*) which is apparently to be separated by the longer rostrum, "reaching middle of third ventral segment." In *descriptus* the rostrum only extends to about the posterior coxae as described by Walker.

## Genus ABANUS.

*Abanus*, Dist. Faun. Brit. Ind., Rhynch. v. p. 81 (1910).

In describing the type of this genus from specimens received from Bengal, I wrote "pronotum elongate, about as long as broad at base." This character from an examination of a series of specimens of another species received from tropical Africa appears to be of a sexual (female) character only, while in the male the pronotum is considerably longer than broad at base.

*Abanus ugandensis*, sp. n.

Head and anterior lobe of pronotum black, basal area of pronotum brownish ochraceous, blackly punctate, and with a central ill-defined pale levigate longitudinal line, lateral pronotal margins pale ochraceous; scutellum black, punctate, elongate, with two small discal spots and the extreme apex

The earliest references to this interesting fish are to be found in Aristotle's 'History of Animals.' A fish having such an extraordinary structure as the sucking-disk and having such unusual habits could hardly be expected to have escaped the keen observation of the Father of Natural History. Yet there is nothing in Aristotle's writings to indicate that he ever saw or at any rate that he ever examined the Echineis with the care which he bestowed on the other animals of which he wrote. In Prof. D'Arcy W. Thompson's scholarly translation (Oxford, 1910), one may read (Book II. 14, 505 b, 19-22): "Of fishes whose habitat is in the vicinity of rocks there is a tiny one, which some call the Echineis or 'ship-holder' . . . . Some people assert that it has feet, but this is not the case: it appears, however, to be furnished with feet from the fact that its fins resemble these organs." Again (Book V. 31, 557 a, 30-31): "In the seas between Cyrene and Egypt there is a fish that attends on the dolphin which is called the 'dolphin's louse.' This fish gets exceedingly fat from enjoying an abundance of food while the dolphin is out in pursuit of its prey."

In a footnote, Prof. Thompson identifies this fish as *Naucrates ductor*, a pilot-fish found in the Mediterranean. Now the term pilot-fish is applied rather indefinitely to a number of different fishes. The *Echineis* or *Remora* is possibly the one best known, from its habit of sticking to dolphins, sharks, or any large fishes and swimming before their snouts. In our waters *Seriola zonata* and *S. carolinensis*, amber-fishes of the family Carangidae, are found associated with sharks and are called pilot-fishes. They are likewise found around the rudders of vessels and hence are also called rudder-fishes. The *Naucrates ductor* of Prof. Thompson is a pilot-fish of the same family but of a different genus. It is found in warm waters throughout the world and has the same habits as the other pilot-fishes.

Thompson's footnote thus leads one away from the idea that the "dolphin's louse" is a sucking-fish, but it should be noted that this last reference comes in a section devoted to sucking insect parasites, lice, ticks, and fleas, and concludes with those crustaceans, "sea-lice" so called, which live parasitically on fishes. So from this internal evidence it seems probable that the fish referred to is an Echineid, a sucking-fish, which attaches itself in a louse fashion to the dolphin as these fish are known to do\*.

\* In a short note published in 'Science' for September 1, 1916, the present writer endeavoured to show that Prof. Thompson's identification

In corroboration of the foregoing, Hasselquist may be quoted. In his 'Journey to Palestine' (1757) he notes that the Arabs at Alexandria called the sucking-fish (*Echeneis neurates*) "*Chamel l Ferrhun*." Dr. Frank R. Blake of the Johns Hopkins University has been good enough to pass on this Arabic name. He writes that *Chamel* means louse, and that *ferrhun* is probably—or, at any rate, possibly—an erroneous transliteration for the Arabic *ferihun*, meaning agile or nimble. And that this meaning fits the actions of the fish, anyone knows who has ever tried to catch with a dip-net a shark-sucker from off its selachian host—it dodges as expertly as a squirrel around a tree. However, Dr. Blake says that there is an Ethiopic word *ferihun*, meaning terrible, and that Hasselquist's name may mean "the louse of the terrible one," and since this fish is found most frequently adhering to the shark, this translation seems the most logical one.

In further corroboration of the contention that the "dolphin's louse" is the *Echeneis*, another eastern traveller, Forskäl (1775), may also be quoted. At Djidda, a town on the eastern side of the Red Sea about midway between Suez and Aden, Forskäl collected *Echeneis neurates*, and was at especial pains to note that the Arab fishermen there called it "Keide" or "Kaml el Kersh," which he translates "the louse of the shark"; while at Loheia, a town on the same side of the sea, but further towards the south-east, it is called "Keda." Dr. Blake has further obliged me by passing on these terms also. He finds that "Kaml el Kersh" means "the louse of the fish of prey," which fish Forskäl tells us in the context was a shark belonging to the genus *Carcharias*. *Keda*, he thinks, is probably a transliteration of the Arabic *Keide*, a fetter or band, hence "the attached one." Still other testimony may be adduced as to the even more recent use of this name. The German traveller Rüppell in his 'Fische des Rothen Meeres' (1835), published only some eighty years ago, says of *Echeneis*: "In the northern part of the Red Sea it is called *Delka* or else *Gammel el Kersh*,

of the dolphin's louse as *Neurates ductor* is erroneous as is Aristotle's calling the little fish which lives among rocks *Echeneis*. The latter was identified as a goby and the "dolphin's louse" was shown to be a sucker-fish. Prof. Thompson on receiving this short paper very kindly wrote me that, while there might be still some uncertainty about the rock-dweller, he agreed as to the identity of the "dolphin's louse." And now it seems well to incorporate this note in these introductory paragraphs and to add certain other data which have come to hand since the above article was published.

in the southern part *Kied*." The latter names are, of course, variations of those noted above. Dr. Blake has not been able to throw any light on the word *Delka*.

From all this we see that, in the near East where changes take place slowly, *Echeneis* was still called "louse" some two thousand years after Aristotle. While to-day in our own waters, as well as in most tropical seas, there is a certain small Echineid fish which Gill (1862) has named *Phthierichthys lineatus*, the striped louse-fish.

To return now to Prof. Thompson's "tiny fish whose habitat is in the vicinity of rocks." It seems to me that this fish cannot possibly be an *Echeneis*. The *Echeneis* is not a "tiny" fish, since the adult forms generally range in length from ten inches to three feet; likewise, so far as is known to naturalists, it does not dwell among rocks. In fish literature of the medieval and renaissance times, however, we do frequently run across references to *Echeneis* as a dweller among rocks, but I take these accounts to be merely echoes of Aristotle, since they are in other respects mere copies of preceding writers. Furthermore, this fish is said to have feet or, at any rate, fins re-sembling such organs. To the present writer there is no doubt that the fish here referred to is a goby, for gobies are small fish, are found in or near rocks, and have their forwardly-placed pelvic fins transformed into hand-like or sucker-like prehensile organs\*.

#### THE MYTH OF THE SHIP-HOLDER.

It will be remembered that Aristotle (384-322 B.C.) calls our fish *Echeneis*, ship-holder, but that he nowhere refers to the miraculous power alluded to by other but later writers. So it is doubtful whether he knew of these alleged powers, but if that be true why should he have named it ship-holder? His words are "which some call the *Echeneis* or 'ship-holder,'" and he is evidently quoting some previous writer, or giving the name in common or everyday use. One thing is clear, i. e. he is *not* the originator of the term, nor is it very evident that he knew the fish by personal observation.

Before bringing to the attention of the reader the various stories ascribing miraculous powers to our fishes,

\* Since writing the above I have found that Lowe, so long ago as 1843, expressed the belief that Aristotle's *Echeneis* was a blenny or a goby or a *Chironectes* and that the dolphin's louse was an *Echeneis*. On both of these points Gunther (1860, 1880) likewise is in agreement with the author of the 'History of the Fishes of Madeira.' Day (1890-84) also has briefly expressed his belief in this identification.

figures of the fishes themselves are presented. Pl. XV. of this paper shows *Leptecheneis naucrates* (fig. 2) and *Remora brachyptera* (fig. 3), which are commonly found in our Atlantic waters. The essential external differences between the fishes are readily seen from the figures. Fig. 1 shows the sucking-disk of the Remora. Consideration of the structures of these fishes is reserved for a later paper.

The first definite reference to the ship-retarding power of the Echeneis is in a poem on fishing, "Halientica," by the Latin poet, Ovid (43 B.C.-17 or 18 A.D.). Verse 99 reads: "Parva Echeneis adest, mirum, mora puppibus ingens"; which may be translated, "The small Echeneis is present, wonderful to say, a great hindrance to ships."

Pliny the Elder (23-79 A.D.) twice refers to the Echeneis. In Book IX. Chapter 41 of his 'History of Animals' he says: "It is believed that when it (Echeneis) has attached itself to the keel of a ship its progress is impeded, and that it is from this circumstance that it takes its name." This (together with other data extraneous to our subject) is taken from Aristotle. Then Pliny quotes one Mucianus (about whom nothing has been obtained) that a murex, a kind of gasteropod mollusk, has a similar ship-retarding power, and gives from this writer an alleged instance of a ship being held by it. Pliny in the same chapter quotes one Trebius Niger that the fish is about one foot in length and that it can retard ships. I have been unable to find out anything about this writer; this reference, like the one to Mucianus, is entirely obscure\*.

In Book XXXII. Chapter I, Pliny gives what is the first detailed account of the ship-holding power possessed by the Echeneis, and it seems well to quote him *in extenso* as given in Bostock and Riley's translation (1857).

"And yet all these forces [winds, tides, &c.] . . . . a single fish, and that of a very diminutive size . . . the fish known as the 'Echeneis' . . . possesses the power of counteracting . . . . A fish bridles the impetuous violence

\* Pliny also gives two other uses of the Echeneis, which though outside the scope of this paper, are of enough interest to appear in a footnote. The first (which he seems to have had from the Greeks) is its use in love philters, and for the purpose of delaying judgments and legal proceedings; all of which he justly says are evil properties, compensated for, however, by its use to stay the flow of blood in pregnancy and for the preservation of the fetus *in utero*. The second use, quoted from Trebius Niger, is that when preserved in salt it is able to draw up gold from the bottom of the deepest well. These fictions are gravely repeated by many writers down to the middle of the seventeenth century . . . at least as late as the time of Rabelais (1553).

of the deep, and subdues the frantic rage of the universe—and all this by no effort of its own, no act of resistance on its part, no act at all, in fact, but that of adhering to the bark . . . . .

“At the battle of Actium, it is said, a fish of this kind stopped the praetorian ship of Antonius in its course, at the moment he was hastening from ship to ship to encourage and exhort his men, and so compelled him to leave it and go aboard another. Hence it was, that the fleet of Caesar gained the advantage in the onset, and charged with redoubled impetuosity. In our own time too, one of these fish arrested the ship of the Emperor Caius (Caligula) in its course when he was returning from Astura to Antium: and thus, as the result proved, did an insignificant fish give presage of great events; for no sooner had the emperor returned to Rome than he was pierced by the weapons of his own soldiers. Nor did this sudden stoppage of the ship long remain a mystery; the cause being perceived upon finding that, out of the whole fleet, the emperor’s five-banked galley was the only one that was making no way. The moment this was discovered some of the sailors plunged into the sea, and on making a search about the ship’s sides, they found an Echeneis adhering to the rudder. Upon its being shown to the emperor, he strongly expressed his indignation that such an obstacle as this should have impeded his progress, and have rendered powerless the hearty endeavours of some four hundred men. One thing too, it is well known, more particularly surprised him, how it was possible that the fish, while adhering to the ship, should arrest its progress, and yet have no such power when brought on board”\*.

This full and circumstantial account by Pliny is of great value, and the more so since everything leads one to believe in Pliny’s full credence in the wonderful power of the ship-stayer. In the paragraph following the above, our old Roman naturalist thus refers to its Latin name: “Some of our own authors have given this fish the Latin name of ‘mora’ [delay],” another reading gives “remora.”

The next of the ancients to write of our fish is the famous historian, Plutarch (46 A.D.). In his ‘Symposiasts,’ Book II.

\* Bostock and Riley say in a footnote, “And well might it surprise him. If there was any foundation at all for the story, there can be little doubt that a trick was played for the purpose of imposing on Caligula’s superstitious credulity and the rowers as well as the diving sailors were privy to it.” Later it will be shown how entirely erroneous is this conjectural explanation of Pliny’s translators.

question 7, he says: "Chæremonianus the Thrallian, when we were at a very noble fish dinner, pointing to a little, long, sharp-headed fish, said the Echeneis (ship-stopper) was like that, for he had often seen it as he sailed in the Sicilian sea, and wondered at its strange force; for it stopped the ship when under full sail, till one of the seamen perceived it sticking to the outside of the ship and took it off." But there was incredulity even in that day for Plutarch adds, "Some laughed at Chaeremonianus for believing such an incredible and unlikely story." Then Plutarch offers for this phenomenon an explanation of his own which will be given later.

Next we come to Oppian, who flourished late in 200 A.D. In his poem *Halieutica*—"On the Nature of Fishes and the Fishing of the Ancients"—as translated by John Jones, there are some 38 lines in which in very poetical and effusive fashion the action of the "sucking-fish" is described. In short, he tells how the fish clings to the keel of the swift ship and retards it, though the wind causes the sails to belly out. He seems, however, to have confused with the Echeneis the lamprey eel which has a round suctorial mouth.

The last of the ancients to catalogue the myth of the ship-detainer was Aelian, a Roman author contemporary with Oppian in the latter part of the third century A.D. In his '*De Natura Animalium*,' Book I. Chapter 36, he refers to "that fish which all men call remora because it holds back and delays ships." And, again, in Book III. Chapter 17, he tells us in very interesting fashion that: "Echeneis is a pelagic fish, black in appearance, equal in length to an average-sized eel, and named for the thing it does. For adhering with its teeth to the extreme stern of a ship driven by a following wind and full sails, just as an unmastered and unbridled horse is held in with a strong rein, so the fish overcomes the most violent onset of the winds and holds the ship as if tied fast to her wharf. In vain the middle sails belly out, in vain the winds rush forth, it holds steady the thing to which it adheres. The sailors know this indeed for the cause of this matter. Hence the name given to this fish, which, because of their experience with it, they call Echeneida (Remora)."

We next hear of the ship-holder in the writings of the early Christian Fathers, and I am able, thanks to the kind help of Dr. Eastman, to quote herein from two. The first of these seems to have been Saint Basil, sometimes called the Great, bishop of Caesarea in Cappadocia. In his



Hexameron\*, Homily VII. paragraph 56, he writes: "If now you hear say that the greatest vessels sailing with full sails are easily stopped by a very small fish, by the Remora, and so forcibly that the ship remains motionless for a long time, as if it had taken root in the middle of the sea, do you not see in this little creature a like proof of the power of the creator?"

St. Ambrose (340-397) in his 'Hexameron,' the first edition of which bears the imprint Basileæ, 1566, describes Echinus (probably a misspelling of Echeneis) as a foreteller of storms. "At the approach of a tempest the fish lays hold of a rock and sticks fast to it until calm weather returns. The sailors, noting this, govern themselves accordingly." This is probably an echo of Aristotle's little fish found among rocks, and seems to be the first of a long succession of similar stories, ascribing to this fish weather-forecasting powers. St. Ambrose, however, does not seem to give the ship-holding story.

Jorath, who was probably an Oriental Christian of the twelfth century, speaks of a fish called Achandes which sticks fast to ships in the sea, thus making them to stand stock still †.

About the year 1250, Bartholomew Anglicus wrote his encyclopedic work 'De Proprietatibus Rebus,' which was translated by John Trevisa in 1397, and printed at Winchester in 1491. The following is his interesting account of the ship-holder, for which also I am indebted to the kindness of Dr. Eastman:—

"Enchirius is a little fish unneth [only] half a foot long; for though he be full little of body, nathless he is most of virtue. For he cleaveth to the ship, and holdeth it still steadfastly in the sea, as though the ship were on ground therein. Tho' winds blow, and waves rise strongly, and wood [violent] storms, that ship may not move nether [neither] pass. And that fish holdeth not still the ship by no craft but only by cleaving to the ship."

In 1475, Johann von Cuba (or Cube) published at Metz his 'Hortus Sanitatis.' In the edition of 1536 on page 78 of chapter 34 he discourses of Echeneis or Echinus. This,

\* "Hexameron is the title of nine homilies delivered by St. Basil on the cosmogony of the opening chapters of Genesis . . . . Basil read the book of Genesis in the light of scientific knowledge of his day. He was born in 329 and died in his fiftieth year.

† For this reference I am indebted to Dr. Eastman, who ran across it on page 71 of Von Cuba's 'Hortus Sanitatis,' to which reference will be made later.

he says, is a little foot and a half long fish which lays hold of ships and causes them to stand still as if rooted in the sea, being held by nothing save the little fish. His story adds nothing to what we already know, but he does one thing which is of great interest, he gives us a quaint figure, which so far as I have been able to find, is the first and only effort to illustrate the myth. It is reproduced as fig. 4 (Pl. XV.). And in this connection one is led to wonder why this story, so interesting to these old-time writers, was not also a favourite theme for illustrators, why it has come down to us with but one picture.

In the 'Annotationes' of Francisco Massari, published at Basilie in 1537, there are in chapter 35 some three or four pages of data on the Echeneis, but careful perusal shows that this is but a revamping of the ancients with not a single new legend added, so Massari may be passed without further comment.

In the year 1550 there was published at Lugduni 'Liber I. De Sympathia et Antipathia Rerum' by Hieronymus Frascatorius, on page 24 of which is the statement that, "Furthermore it seems to be beyond all doubt that Echeneis is that little fish which we call Remora, which causes to stand still in mid-ocean the ship moved by the force and impetus of the wind" \*.

According to both Gesner and Aldrovandi, there is to be found an account of the ship-holding power of Echeneis in Adam Lonicer's 'Naturalis Historiæ Opus Novum in Quo Tractatur de Natura,' etc., Frankfurt, 1551. The only edition found in New York is the German translation, which appeared as 'Kreuterbuch' in 1560. Dr. Lydenberg kindly looked through the 1682 edition of this in the New York Public Library, but could not find any reference to Echeneis. I have not been able to locate another copy. However, in Gesner's 'Historia Animalium,' IV. (1558), and also in Aldrovandi, there is a considerable quotation from Lonicer with reference to Echeneis. Careful study of this, however, shows that no new data are given.

The account of Edward Wotton (1552) is but a rehash of Aristotle, Pliny, and the other Greek and Roman writers. His one statement worthy of repetition reads "Let the winds rush and the tempests rage, the Remora dominates the furor, overcomes these great forces, and compels the vessels to stand still, which no chain and anchor have been

\* For a transcript of Frascatorius I am indebted to the courtesy of Mr. Charles Perry Fisher, Librarian of the College of Physicians, Philadelphia.

made heavy enough to do." This, however, seems to be taken from Pliny.

In the sayings of Pantagruel, Rabelais (1553), in Book IV. Chapter 62, has the following:—"... an Echeneis or Remora, a silly, weakly fish, in spite of all the winds that blow from the thirty-two points of the compass, will in the midst of a hurricane make you the biggest first-rate remain stock still, as if she were becalmed, or the blustering tribe had blown their last." And again, in Book V. Chapter 26: "... there (in the country of Satin) I saw a Remora, a little fish called by the Greeks Echeneis, near a big ship which was motionless although under full sail, on the high sea."

We now come to Rondelet (1558), who attempts to show that the retardation of ships might have been effected by the Echeneis of Pliny, the great shell-fish of Mucian, or the eel of Oppian. Indeed, he asseverates (page 313) that he has known a lamprey to thus hold back a boat: "... it [Oppian's eel] stops it and holds it [a boat] back; a thing which corresponds to our lamprey, and which I have known through experience, for if it puts its mouth against a boat it stops it, and I have seen it thus." Then he adds, "There is no need to marvel that various fishes are called by different authors by the same name, nor that the same fish be called by many and divers names, for that often happens." For the rest, Rondelet quotes and comments on the accounts of Pliny and others on the true Echeneis (pp. 334-5), but adds nothing of himself. More might be expected of this great ichthyologist; but it seems that he never saw the fish (he gives no figure of it) and knew nothing of it at first-hand.

Conrad Gesner was the greatest of the encyclopedic writers of natural history, and his '*Historia Animalium*,' Books I.-VIII., was published Basel, 1551-1558\*. In Book VIII. he discourses at considerable length "Concerning Echeneis or Remora," but there is nothing in his writings to indicate that he ever saw the fish. He adds no new data; but this section of his book is of value because in it he quotes a large number of the writers previously cited in this paper. However, even here his value to the student of ichthyological archaeology is crippled by the fact

\* It will be noted that the works cited of both Gesner and Rondelet are dated 1558, and yet Gesner quotes Rondelet at considerable length. However, the apparent discrepancy disappears when it is remembered that Rondelet's '*L'Histoire Entière des Poissons*' is but a translation into his native French of his original work first published in Latin in 1554.

that he quotes his predecessors by name only, rarely by book or chapter. He adds nothing to our knowledge of the Myth.

Gesner, however, is the first writer since the ancients to attempt a description of Eche-neis. This description, which is found in the last paragraph of his section on the Eche-neis, is evidently that of a goby, and is quoted here that the reader may judge for himself, and not be led into the error of crediting Gesner with the first description.

"There is a little fish found in the ocean at Emda in Frisia (so a certain friend has related to me) four digits long; of very slimy skin, without scales, having a head large in proportion to its body, eyes small, the rest of the body cone-shaped. Under its chin it had the form of a sucker by which it probably adheres to rocks, for when he pressed this cavity with his finger (so my friend narrated it) it adhered to it so that it could be carried about."

In Chapter XXXVII. of Liber X. of his '*Operum*,' published at Lugduni in 1561, Jerome Cardan writes of the action of the Remora as if it were a settled fact, but adds nothing of value to detain us here. He will be referred to later as offering an explanation of the ship-staying powers of the fish.

Departing from the beaten track of repeating what some previous writer had copied, the Dutchman, Jan Huygen van Linschoten, or, as his name is Latinized, Joannes Hugo Linscotanus (1596), gives the following interesting and detailed account of the ship-holding power of the Remora:—

"And because I am now in hand with the Fishes of India, I will here declare a short and true Historie of a Fish, although to some it may seeme incredible, but it standeth painted in the Viceroyes Pallace in India, and was set downe by true and credible witnesses that it was so, and therefore it standeth there for memorie of a wonderful thing; together with the names and surnames of the ship, Captaine, day, & yere when it was done, and as yet there are men living at this day, that were in the same shippe and adventure, for that it not long since, and it was thus. That a ship sayling from Mosambique into India, and they having faire weather, a good fore winde, as much as the Sayles might brave before the winde, for the space of fourteene dayes together, directing their course towards the Equinoctiall line, every day as they tooke the height of the Sunne, in stead of diminishing or lessening their degrees, according to the Winde and course they had and held, they foud themselves still contrarie, and every day further backwards then they were, to the

great admiration and wondering of them all, and contrarie to all reason and man's understanding, so that they did not only wonder thereat, but were much abasht beeing steadfastly perswaded that they were bewitched, for they knew very well by experience that the streame or course of the water in these countries did not drive them back, nor withhold them contrarie to all Art of Navigation, whereupon they were all in great perplexity and feare, standing still and beholding each other, not once knowing the cause thereof.

"At ye last the chiefe Boteson, whom they call the masters mate, looking by chance overbord towards the beakhead of the ship, he espied a great broad taile of a Fish that had winded itselfe as it were about the beakehead, the body thereof beeing under the keele, and the heade under the Ruther, swimming in that manner, and drawing the shippe with her against the wind and their right course: whereby presently they knewe the cause of their so going backwards: so that having at last stricken long with staves and other weapons uppon the fishes taile, in the ende they stroke it off, and thereby the fish left the ship, after it had layne 14 dayes under the same, drawing the ship with it against wind and weather: for which cause the Viceroy in Goa caused it to be painted in his pallace for a perpetuall memory, where I have often read it, with the day and the time, and the name of both shippe and Captaine, which I cannot well remember, although it bee no great matter" \*.

Ferrante Imperato, a pharmacist of Naples, having a taste for natural history, formed a collection of such objects, and made the description of these the basis of his book '*Historia Naturale*,' published at Venetia, 1599. In this he writes: "Although the Remora of the ancients has by many been described under the forms of different fishes, there is, however, no description that fits except the one proposed by us. It has on the upperpart of the head tentacles similar to the vibratile combs [cirri, literally ringlets] of the polyps by which it attaches itself to ships or the bodies of large whales and other fishes."

With the above description Imperato published a figure of

\* Linschoten's book was first published in Dutch at Amsterdam in 1596, but was translated into English and published in London in 1598, while in the following year (1599) a Latin version appeared at Amsterdam. The above account is taken literally from the English edition. For photostats of it and of the original Dutch edition I am indebted to the kindness of Dr. Lydenberg, who not only sent these, but who had previously in a most skilful manner run down Linschoten from an exceedingly indefinite and obscure reference in Nieremberg to the "*Pro-Rex of Joannes Hugo*."

Echeneis or Remora which, so far as I have been able to find, is the earliest portrayal of the sucking-fish. This is reproduced herein as fig. 5 (Pl. XVI.). It correctly shows the projecting lower jaw, the position and general make-up of the sucking-disk, and the position of all fins, especially the long dorsal and ventral ones. The tail is not good. It is probably a Remora, since there is no effort to portray the lateral stripe of Echeneis. The crudity of the figure is, of course, apparent, but it is the *first*, and it is a fair portrayal. The disk is clearly shown, and in the description its function is definitely indicated for the first time in history\*.

We come now to another original story of the wonderful power of the Remora. It is quoted from Ekman (who will be referred to later), who says that it was told by Bartolomeo Crescentio Romano in his book '*Nautica Mediterranea*' published at Rome in 1607. This book I have not seen.

"... and I must tell you about another deed of the devil, because you must know in how many ways this enemy of mankind works against poor seamen.

"On a voyage from Gaeta to Napoli, the galley '*S. Lucia*,' when sailing before a fresh wind and being two miles from port, stopped quite immovable in spite of her sail being strained. The steersman examined the rudder to see whether there was some rope or net fastened to it, and as nothing was found, he commanded the oars to be got out and the galley slaves to be forced on with hard blows. But the galley did not move from the spot, and when she had been lying motionless for a quarter of a hour or more, the other galleys, which had sailed on, shortened sails, waiting. Then a man named Catelano told the captain... to have three monks removed from the deck of the galley, and averred that the galley would then immediately begin to move; and when the captain had them removed, the galley certainly did begin to speed like an arrow.

"Then all the men were about to throw these three poor fellows into the sea, saying that they were excommunicated; but the same man Catelano helped them saying, that this was a stratagem of the devil to the detriment of the monks; and he obtained permission that they should only be taken from the vessel.

"This occurrence would have caused scientific men to suppose that a very small fish, resisting the progress of the

\* The above figure and description are taken from the 1589 edition of Imperato's book found in the library of the Academy of Natural Sciences of Philadelphia. For it I am indebted to the kindness of Dr. Edward J. Nolan, Librarian.

vessel, had got the better of the force of the sails and oars and made the vessel stop."

We next come to another great ichthyological encyclopedist of the Renaissance, Ulyssis Aldrovandi, whose huge folio, '*De Piscibus et de Cetis*,' was published in 1613 at Bononiæ. This author devotes to the Remora some five pages, which are taken chiefly from Gesner. He discourses at considerable length of the ship-holding power of the Remora, and quotes Aristotle, Pliny, Rondelet, and several others of the authors previously considered in the present paper. However, it seems probable that he never saw the fish—at any rate, a careful translation of his very difficult Latin nowhere reveals any definite statement that he had seen it. However, he does the one good thing of giving us a figure and description which adds materially to our knowledge. A photographic reproduction of his drawing is given here as fig. 6 (Pl. XVI.). Note that it is labelled the "Remora of Imperato and the author." Aldrovandi expressly says "... my drawing corresponds with that one's," but his figure looks like an Echineis, and his description below confirms this idea. He says:—

"The color of the whole body almost inclines to violet, its sides are glistening, the body is cut into two in the middle by a sub-green line, and its tail verges to blue. There are six fins to the body, three on the belly, two each in the region of the stomach and one at the anus. Likewise there is one on the back, and the tail ends in another. . . . Its mouth is not unlike a dog's except that the lower jaw projects beyond the upper jaw contrary to that which we see in the shark. I think that this is a truer figure [than Imperato's]"\*.

This description seems to have been made from the fish rather than from the drawing, since the latter does not show the median line. It is to be regretted that Aldrovandi does not give us a definite statement on this point.

Aldrovandi, in his discussion of the Remora, gives this interesting incident:—"Within the memory of our parents, it is said that the ship of Franciscus Turonensis, the Cardinal, when he was once upon a time going from Gaul by maritime journey into Italy, according to the narrative of Peter Melara of Bologna, a very brave knight and at the

\* For the scholarly translation of Aldrovandi, I am indebted to Mrs. S. P. Ravenel, and to Miss Julia Dameron, associate professor of Latin in the College. Miss Dameron has also been so kind as to help me with a number of the other Latin articles herein referred to.

same time a very learned man, was delayed by a very small fish in the midst of its course" \*.

The reference made to this same incident by John Johnston, in his book 'A History of the Wonderful Things in Nature,' London, 1657, on page 301, is probably taken from Aldrovandi.

At Geneva, in 1614, Bartholomew Keckermann published his works, and in his 'Disputationes Physicæ' he discusses the ship-staying power of the Remora. He adds nothing to our knowledge of the myth, but does offer an interesting explanation, which will be considered later.

We next come to Rochefort, whose interesting and instructive book on the Antilles was published at Rotterdam in 1665, who says that certain fish bear the name Remora "because they adhere to vessels as if they wished to arrest them in their course." Note the clause "as if they wished." The old order is passing away, men are beginning to seek a rational explanation of the retardation of ships, and doubt is being cast on the efficacy of the Remora as the agent. \*

So more explicitly writes Du Tertre, whose valuable natural history of the Antilles was published but two years (1667) after Rochefort's work. In the course of his description of the Remora and explanation of its activity, he writes:—

"For myself I hesitate to submit my judgment to that which some authors assure us concerning the Remora, saying that it brings to a full stop a ship which sails before the wind with canvas stretched on a full sea. Since there is so great a quantity of Remoras around the Western Isles, one could scarcely find a ship that would not have several attached to her, yet nevertheless during the century or more that these islands have been frequented, it has never been noted that a single ship has been thus arrested by the Remoras. This has caused me to think that the two or three vessels, which have been said to have been arrested by the Remoras, have been detained by some miracle or charm, and since at the time some Remoras have been attached to them

\* Being unable to do anything whatever with this reference, I referred it to Dr. Lidenberg, who very kindly went into the matter fully. He finds that there was a Peter Melara of Bologna who left certain MSS. which are or were to be found in the "Biblioteca dell' Istituto" of that city. He suggests that Aldrovandi had access to this particular MS. This conjecture is strengthened when one remembers that Aldrovandi lived, wrote, and published his book in Bologna. Note, further, that he prefaces his statement by saying "within the memory of our parents."



in their usual fashion, to these have been falsely attributed the cause of their detention."

It will be shown later how closely Du Tertre came to a true explanation, and it is to be regretted that in substituting one mythical explanation for another he narrowly missed the truth. Therein he was better churchman than naturalist.

Le Maire (1695) writes "Le Sucez [Echeneis] is so called because it attaches itself by sucking. It is in size about equal to a sole. When it attaches itself to the rudder, it retards the vessel, but does not stop it as the Remora is falsely said to do."

In the face of what has just been quoted there is now to be presented from one of the most remote corners of the world another and much later story of the Myth. Faber, in his 'Natural History of the Fishes of Iceland' (1829), gives the following circumstantial account:—

"In Jan Olsen's MS. it may be read [that]: 'In the year 1720; by chance it happened on the strand before Hunevand's Harde (in Nordisland) with a boat which had been rowed out for the autumn fishery, that when the fishermen wished to return they could not move the boat, although they rowed with all their might. Then there was noticed behind on the rudder a short stumpy fish, blackish-gray in color, which moved itself a little and adhered so solidly to the boat that one could scarcely pull it loose with the hand. It left behind on the boat a mark of its body, and when it was pulled loose the boat went forward. The fishermen burned it on the shore whereby a great stench was produced. This animal appears to have been a Remora, and through this account the matter seems to be confirmed that there are really such living fish which can bring a ship to a standstill.'" Faber then concludes: "The exaggeration of the account being allowed for, it is not to be doubted this was a sucking fish."

There is now to be given the latest and most modern account of retardation by the Remora that has come to light. In 1778 there was published in London, "Translated under the author's inspection," the 'Travels in Dalmatia' of the Abbé Alberto Fortis. The locality, it should be noted in passing, is not very far removed from the countries Greece and Rome, in which the legend originated. In a letter to Signior Marsili, Professor of Botany in the University of Padua, Fortis writes:—"I will finish this letter by relating a fact, to which you may give that degree of faith which you think it merits. You have often read in ancient natu-

ralists, of wonderful things done by the Remora, or Echeneis and not without some surprise will have learnt Pliny's story, who after having told us, on the faith of another, how Anthony was retarded on his voyage by means of this fish, asserts positively, that a ship with Caligula on board and four hundred rowers, was actually stopped by one of these fishes, while the rest of the fleet went on at a great rate. When I read this, I contented myself to shrug my shoulders, without perplexing my brain to find out by what natural processes, or matter of fact, such an opinion could become so generally received, that a man of sense as Pliny certainly was, should affirm it in positive terms. But chance led me to the discovery. We were sailing in a small bark between Vruillia and Almissa with a fresh equal gale, in the afternoon. The mariners were all at rest, and the steersman only was awake, and attended alone in silence to the direction of the bark; when, on a sudden, we heard him call aloud to one of his companions, ordering him to come and kill the Paklara. Our learned friend Signior Guilio Bajamonti was with me, and understanding what the man meant, desired him to show him the fish that he wanted killed, but the fish was gone. Having interrogated the steersman, who did not want sense, and was a fisherman by profession, why he had ordered the Paklara killed, and what harm it had done; he answered, without hesitation, that the Paklara used to take hold of the rudder with his teeth, and retarded the course of the bark so sensibly, that not only he, but every man who sat at the helm felt it there without seeing it. He added, that many a time he himself had caught the Paklara in the act and had frequently killed and eat it. That it was often met with in the waters of Lissa. That in shape it resembled a conger eel, and in length did not usually exceed a foot and a half. That if I had a mind to see, and catch one of them I needed only to go in a fishing boat, in the warm season, between the islands of Lessina and Lissa, where he had never failed to meet with them every year. I will not desire you to believe everything my pilot said; but confess that I should be very glad to see the Paklara when it had taken hold of the rudder of the bark under sail. The wonderful strength of the muscles of some little marine animals, such as the *Lepades*, that so obstinately resist any attempts to disengage them from their rocks, the stroke proceeding with such rapidity from the Torpedo, known at Venice by the name of *pesce tremolo* and in the sea of Dalmatia by that of Truak; the vigor shewn by the *Dentici* in their convulsive motions even when out of their own element, not to mention

the larger fish, such as, Tunny, Dolphins, etc., give me ground to suspect, that if all that the ancients wrote concerning the Remora be not just literally true, it is not altogether false. It certainly is a thing worthy of some reflection, that Pliny speaks so diffusely concerning this phenomenon, as a known fact that could not be called in question. The Greeks adopted the notion of this extravagant faculty, by superstitiously hanging the Remora about women with child, to prevent abortion. I am not, however, so ready to credit these extravagances or in the least persuaded of the wonderful retarding force of this little fish; and think it sufficient to believe that the force of the Paklara may be felt at the rudder of a small bark, without troubling myself further about the Remora.

"The Remora of the ancients, and the Paklara of our days, have this remarkable difference, that the first is almost always of the testaceous kind, and the second is of the genus *Murena*."

From this we see that the Abbé was half convinced of the correctness of the sailor's belief as to the power of the Paklara. However, he thinks this fish to be a lamprey eel, while the Remora of Pliny is in his opinion a shellfish. This is confirmed by a further reference on page 325, which reads as follows:—"Among the curious fishes found in those waters [of Lissa] the Paklara is the most remarkable: I did not see it, but the description given me by the fishermen, agrees with the *Echeneis* of Artedi, and Gouan, though, in my opinion, not with the *Echeneis* or Remora of the ancients."

Before going into an explanation of the Myth of the Ship-holder, it may be of interest to show that the term Remora has attained a place in literature. Among the Romans we find Lucilius saying "A certain voice sounding forth made for you a Remora in your progress." Again, Plautus says "Those things are distasteful which obstruct many undertakings and they make for a Remora both in public and private affairs." However, since the word Remora is a common Latin term for a delayer or retarder, we cannot be sure that its use above is a reference to the fish; more probably it is a use of the term in its original and ordinary sense.

Probably not such, however, is the use of the term by St. Basil (329-379). He affirms that "Life is a voyage and in our life's ways, countries, courts, towns, and rocks are remoras."

In English literature, however, more direct allusions are

to be found. Thus Spenser, in his 'Visions of the World's Vanity,' i. p. 108, writes:—

“ Looking far forth into the ocean wide,  
A goodly ship, with banners bravely dight,  
Through the main sea making her merrie flight.  
All suddenly there clave unto her keel  
A little fish that men call Remora,  
Which stopt her course, and held her by the heel,  
That wind nor tide could move her thence away.”

And Ben Jonson says ('Poetaster,' III. 1):—

“ I say a remora,  
For it will stay a ship that's under sail.”

And again, in his Act III. Scene I, he makes Horace say to Fuscus Aristius of Crispinus, a great bore, who had nearly talked him to death:—

“ ARISTIUS. What ails't thou man?  
HORACE. 'Death, I am seized on here,  
By a land remora: I cannot stir,  
Nor move but as he pleases.”

Mamdrell, in his 'Aleppo to Jerusalem' (p. 46) writes:—  
“ We had his promise to stay for us, but the remoras and disappointments we met with in the Road had put us backward in our journey.”

And again, Jeremy-Taylor quaintly says:—“ A gentle answer is an excellent remora to the progressses of anger, whether in thyself or others.”

Before leaving this part of the subject, the following story may be added as of interest. In David Livingstone's 'Missionary Travels and Researches in South Africa' (New York, 1858), on page 556, in writing of the Barotse valley on the Lueba River, one of the headwaters of the Zambesi, he says:—“ The Barotse [people or tribe] believe that at certain parts of the river a tremendous monster lies hid and that it will catch a canoe, and hold it fast and motionless, in spite of the utmost exertions of the paddlers.”

In the Indian Ocean around Zanzibar the Remora abounds in great numbers, and is used, as I shall show in another paper, for the purpose of catching turtles by virtue of its propensity for clamping itself fast to any floating object. At first I was inclined to think that the Barotse myth was a

far distant echo of the Zanzibar stories; but Livingstone shows very conclusively that the inhabitants of the upper Zambesi in his day had no communication whatever with the coast. Such communication may have existed at an earlier day, and at that time the story may have been brought inland, or it may have arisen spontaneously. At any rate, it is very curious and is worth repeating in this connection.

#### THE MYTH EXPLAINED.

##### *First Explanation: Foul Bottoms.*

In giving the explanations of the Myth of the Ship-holder, it seems best to take them up chronologically, for, as might be expected, even in ancient days there were men whose minds sought a rational explanation.

The first person who attempted to clear up this matter seems, so far as can be found, to have been Plutarch (16 A.D.). On page 277 his account of the statement of Chæremonianus the Thrallian has been given, and it will be recalled that the latter was laughed at for believing such an extraordinary thing. However, Plutarch, entering into the conversation, said:—

"Therefore as those things mentioned are but consequences to the effect, though proceeding from one and the same cause, so one and the same cause stops the ship, and joins the Echeneis to it; for the ship continuing dry, not yet made heavy by the moisture soaking into the wood it is probably that it glides lightly, and as long as it is clean, easily cuts the waves; but when it is thoroughly soaked, when weeds, ooze, and filth stick to its sides, the stroke of the ship is obtuse and weak; and the water coming upon this clammy matter, doth not so easily part from it; and this is the reason why they usually scrape the sides of their ships. Now it is likely that the Echeneis in this case, sticking upon the clammy matter, is not thought an accidental consequence to this cause, but the very cause itself."

Now it must be conceded that this is a reasonable explanation, and we will find that until the middle of the sixteenth century it was repeated as explanatory of ship-retardation.

Gesner (1558) quotes Plutarch at length, insists on the retarding effect of mosses and algæ ("multa alga & musco innascere"), and plainly shows that he regards these (among which the Echeneis is found) as an efficient cause in the slowing up of the speed of ships rather than the action

of the fish itself, although nowhere he expresses a disbelief in this power of the Echeueis.

Laevinus Lemnius \* (1559), in discoursing of "Sea-weed and Sea Fucus," apparently only amplifies Plutarch when he says:—

"But Mosse must be held to be a thing different from these: one kind whereof grows not only on the shores, but upon the sterns of the ships, when they come home from long voyages, to which not only Mosse and Sea-weeds, but shell-fish and a little fish called Echeueis stick so fast, that they will stop Ships, and hinder their courses, therefore our men use to rub them off with sharp brushes, and scrape them away with irons that are crooked for the purpose, that the ship being tallowed and careened well and smoothly may sail the faster."

Aldrovandi, Gesner's great successor and copier (1613), devotes several pages of his huge folio to "Occultane an Manifesta Vi Naves Remoretur," most of his data being taken from Gesner. He gives at length Plutarch's explanation of the retardation as due to growths of marine algae among which the Echeueis chugs, thus being "not the cause of the retardation of the ship but an accident of the effecting cause."

Aldrovandi is the last of those who allege the growth of sea-weeds as a cause of the retardation. It began to be seen that, while such marine growths would slow up a ship, they did not explain the remarkable instances of retardation in which the speed of the vessel was checked for a while but which was presently regained. However, another attempt had been made to explain these erratic movements of vessels, and this will now be given.

*Second Explanation: The Adhering Remora acts as a Rudder.*

This seems to have been first advanced by Rondelet (1558) in these words:—

"Pliny and others are greatly astonished that it is possible for this fish to have the power to stop a moving vessel propelled by sails and oars; but, as Aristotle says, one wonders at many things of which one does not understand the cause . . . which we will give concerning the effect of

\* Lemnius's book 'De Occultis Naturæ Miraculis' was first published at Antwerp in 1559. The above quotation is from the English edition.

† 'Concerning the Secret Miracles of Nature,' Book III. Chapter 9, pp. 218-219, published at London, 1658.

this fish taken by itself in the place it requires. Because the rudder is small and placed at one end of the boat it is managed by one man who does not exert himself greatly. In the same way it is easy for that which moves one end to move the whole, for as the force and swiftness of those things which are thrown or moved finally ceases, so at the end of a continuous thing in motion the movement is weak and feeble, and because it is weak it is easily disturbed and overcome. As a boat, which is a continuous thing, goes very swiftly when driven by the winds, the first end called the prow goes more rapidly, and the rear end called the stern goes not so rapidly for in this latter place is the rudder which, moved here and there, makes the prow move easily also, for the reason above mentioned, and consequently the vessel as a whole moves. \*In this way, if a vessel is lightly driven straight ahead, and if the Echeueis or Remora, having put its mouth against the rudder, moves it here and there, it is necessary that this movement through the continuity of the vessel be communicated also to the prow and that it stop in its first course to waver in this direction or that according as the fish moves it; for it is a thing proved by reason, and certified by experience, that however little one of the ends is moved, the other also and indeed the whole of any continuous body is moved in the same way."

In this Rondelet seems to have taken from Aristotle's treatise on Mechanics the latter's explanation of how a rudder causes a ship to change her course, and to have adapted it as seen above to try to show how the Echeueis causes a ship to change her course and be delayed.

The above is a good translation of Rondelet's old and very difficult French \*. In another place, speaking of Oppian's Remora, which he identifies as the lamprey eel, and which is said to stop and hold back vessels, Rondelet affirms that this is "a thing which corresponds to our lamprey and which I have known through experience, for if it puts its mouth against a boat it stops it, and I have seen it thus." Here for the first time we have an eye-witness account of the ship-retarding power of a fish. The lamprey has a round suctional mouth by which it transports stones to make its "nest" at the breeding-season, and by which it fastens itself to fishes. That it should thus fasten on to a vessel is by no means improbable, nor is it improbable that by violent motions it could slow up the speed of a small boat.

The 'De Subtilitate Rerum, Liber X.' of Jerome Cardan

\* For this translation I am indebted to Miss Hinda Hill, head of the Department of French in this College.

seems to have been first published in 1550; however, it was included in his complete works published in 1564 at Lugduni. On page 117 of this edition he has a column devoted to the Remora and its activities. He describes at some length and in bad Latin how the Remora by adhering to the rudder and waving its tail to right and left, turns the ship in first one and then the other direction, thus causing it to waver and lose speed. He compares its action to that of the steersman of a boat, who, using an oar over the stern, influences her course more than all the rowers who are pulling hard.

Gesner (1558) quotes Rondelet at length, but somewhat simplifies the explanation of the latter, saying that when the Echeueis affixes itself to the stern or rudder, and when it moves body or tail it causes the vessel to stand still, or, at any rate, to waver in its course, "just as when in a calm the helmsman turns the ship in her prosperous and swift course over to a more inexperienced steersman who is not able to hold the tiller straight," and hence the ship has a wavering movement and does not make good progress.

Imperato (1599), who, as previously noted, was the first to explain how the Remora fastens itself to vessels or fishes, says:—"It has on the upper part of the head tentacles, similar to the vibratile combs [cirri, literally ringlets] of the polyps, by which it attaches itself to ships or to the bodies of whales and other large fishes and retards their course and restrains them at will; not otherwise than the rudder, while projecting but little from the vessel, has the power of directing its course."

The next writer to proffer the explanation we are discussing is Aldrovandi (1613). However, he starts by quoting Aristotle on the use of the rudder in changing the motion of a ship. He then advances the same arguments which we have found in Gesner and which the latter expanded from Rondelet. However, Aldrovandi argues at considerable length and somewhat ingeniously, but the gist of his argument is that the Remora sticking fast to the stern or rudder by moving its tail or body moves this continuous thing, the ship, causing it to hesitate or even pause in its course. It must be said, however, that Aldrovandi's Latin is so imperfect, and hence so hard to translate, that it is hard to say how much of this is Gesner and how much Aldrovandi.

With the rise of the Renaissance, and the freeing of men's minds from many old-time superstitions, it began to be seen that it was an absurd impossibility any longer to think that one small fish could retard, much less cause to come to a



standstill, a large vessel. And so we find Rochefort (1665) remarking (as noted heretofore) that Remoras "adhere to vessels as if they wished to arrest them in their course."

\*Du Tertre, who was a contemporary of Rochefort, and whose book was published but two years later (1667), had seen a number of Remoras attached to ships in the West Indies, but had never known of a vessel which had been brought to a standstill by them. So he preferred to think that such vessels "had been detained by some miracle or charm."

*Third Explanation\* Large Numbers of Adhering Remoras.*

Dampier, whose 'Voyages' was published in 1697, tells us that he found great numbers of Remoras in the Caribbean Sea and the Gulf of Mexico, and goes on to say with regard to their retarding power:—

"Any knobs or inequalities at a Ship's bottom are a great hindrance to the swiftness of its sailing; and 10 or 12 of these [Remoras] sticking to it, must needs retard it, as much in a manner as if its bottom were foul." And in this conclusion Catesby (1754) fully agrees.

Le Maire (1695) remarks that "*Le Sucez*," if it attaches itself to the rudder, may retard the vessel but cannot stop it, as the old legend falsely had it concerning the Remora. While Leguat (1721) emphatically says that "It is very certain that these fish attach themselves often to vessels in the water, and when the number is sufficiently great, one cannot doubt that they are an obstacle to the course of these floating edifices, since they prevent their easy movement over the waves."

John Barbot (1732) is also very emphatic on this point. Referring to the common notion that the Remora by sticking to a ship can retard it, he says, "... some part whereof might be possible, if a sloop or small vessel had a thousand or more sticking to its sides and stern, they being commonly, at full length, about 3 foot long or better, for then they might considerably retard the sailing of such a vessel; but it is ridiculous to say that they can have any power over great ships under full sail, as is pretended."

In close agreement with Barbot is the great French naturalist Lacépède (1829), who in turn is probably quoting from the naturalist Commerson, from whose manuscripts most of Lacépède's information with regard to foreign fishes seems to have been obtained. After discussing the various

myths concerning the "ship-holder," the French ichthyologist goes on to say :—

"In the midst of these ridiculous suppositions, one truth however stands out; that is that on the instant when the keel of the vessel has adhere to it, so to speak, a great number of echeneises, it would experience in moving through the water a resistance comparable to that which a great number of shelled animals [barnacles?] would make if attached equally on its surface, when it glides with less speed through a fluid which grating on the asperities brings it about that the vessel does not possess the same 'liveliness.' But one does not fail to think that the circumstances under which the echeneises would find themselves thus accumulated [in such numbers] against the timbers and exterior of a ship would be extremely rare in all latitudes."

On this matter Lowe, in his '*Fishes of Madeira*' (1843), after reviewing many of the Greek and Roman legends, makes the following conservative statement :—

"... there is much doubtless of mere fiction or exaggerated fancy; yet, on the other hand, it would be rash altogether to deny the truth. Like most popular accounts or vulgar errors, they may probably be founded on some real circumstances, or natural occurrence, distorted by exaggeration into the wonderful. There would be nothing marvelous, that a Lamprey, of even ordinary size, fixed to the keel or rudder of a boat, suspended by one end and struggling in the water should, as related by Rondelet upon his own experience, greatly retard such vessel's progress, render its course unsteady, and baffle the exertions of the rowers.

"Again it is remarkable that the Dalmatians at this day, as Schneider in his note on Aelian, II. 17. mentions on the authority of the Abbé Fortis, possess the same idea regarding a fish they call Paklara, which the ancients held regarding their Echeneis or Remora. So strange a notion is not likely to have originated from communication with others amongst a wild and illiterate population; or, again, to have sprung up spontaneously and independently without some real ground. Without recourse, therefore, to the marvelous or extraordinary on the one hand, or to mere fiction on the other, it does not seem unreasonable to suppose that the accidental attachment to the rudder of a small sized vessel of some fish like Rondelet's Lamprey may have originated an impression, which has subsequently been generalized and transferred to other sucking-fishes, in themselves incapable of producing like effects."

The soundness, the reasonableness of the conclusions reached by the various writers in the immediately preceding pages will appeal to every reader, but it must be remarked that these are all conjectures, not facts observed and recorded by scientific men. However, just here I am fortunate in being able to give the following quotation from one of the most eminent ichthyologists of the present day, Mr. David G. Stead. In his 'Fishes of Australia' (1906), pages 190, 191, we read:—

"Now, though it would be altogether impossible and out of all reason to suppose that one individual [*Echeneis*] could exert sufficient power to delay or retard a vessel's progress, still an instance has actually come under my notice, in which a sailing-vessel was considerably delayed while in tropical seas through a shoal of 'Suckers' attaching themselves all round its sides and bottom."

Unfortunately, I have had no experience of my own as to the retarding powers of this fish, but in the summer of 1915 I carefully questioned (avoiding all leading queries) one of the most experienced fishermen at Key West, Fla. We had just caught a large shark, and were vainly attempting to hook its sucking-fish attendant, when I related the story of the ship-holder, cast some doubts on it, and asked Griffin what he thought of it. He replied about as follows:—"They sure will hold a boat. I have seen ten or twelve under a boat at one time. This was while king-fish fishing at Bahia Honda. The king-fish were in big schools and were followed by hundreds of sharks. The 'suckers' on the boat came from the sharks. My brother and me had boats just like each other in size and build, but his was a little better sailer than mine. The first day he beat me, both sailing before the wind, but the second day I beat him. He said, 'No wonder I am losing, too many "suckers" hanging on her bottom.' All the Key West fishermen know that 'suckers' will sure hold a boat."

This was corroborated from his own experience by my captain, an educated young Englishman from the Bahamas. And both men agreed that of two fishing-boats of equal size and speed, the one having behind it a "trolling squid" for mackerel will be retarded and will lose in a close race.

In order that the reader may get a clear idea of the "brake" which a good-sized sucking-fish may put on the movements of its host, figure 7 (Pl. XVI.) is introduced just here. This is from a photograph of a model in the United States National Museum of a shark with its adhering *Echeneis*. The fish is about half the size of the shark—say,

3 feet to the shark's 6. Argument is not needed to establish the idea of a "brake." The figure is from a note by R. I. Geare in 'Scientific American' for 1902. Mr. Geare remarks that the shark often becomes "emaciated from the strain of pulling these uninvited guests around." However, it should be stated that in the figure here given the *Echeneis* is much larger in proportion to the size of the shark, so far as my experience goes, than is the case ordinarily. *Echeneis* is known to attain a length of 3 feet. A *Remora* half that size would be extraordinarily large. On the other hand, however, mention should be made of the fact that, while these semi-parasites are small, not infrequently several may be found on one shark. On a shark taken at Tortugas I found three, while one at Key West was infested with four, the largest about 30 inches long.

Scattered throughout ancient and mediæval literature are a number of more or less isolated explanations of submarine cliffs, of magnetic rocks, and of supernatural and inexplicable forces which held vessels as if anchored. These are widely scattered and little emphasized, and it does not seem worth while to go into them. A fair example is that of Kecker-mann (1614), who alleges that the *Remora* sticking to the stern of the vessel pours out a very viscid and cold humour which causes the water around the rudder to be congealed, making the vessel to lose steerage. Again, Johnston (1657) notes that the lodestone has the power of attracting things, and thinks that the *Remora* has some such non-understandable power.

#### *Fourth Explanation: "Dead-Water."*

From the foregoing accounts no one can doubt that a school of *Remoras* attaching themselves to a small vessel can seriously arrest it in its course, but that they could noticeably retard a large sailing-vessel or a steamer is absurd. However, there is not lacking evidence from the days of Pliny to the present time that large sailing-craft and in our times even steamboats have been mysteriously checked in their courses and even stopped almost or quite still. These being facts, it is necessary to find an explanation for them. This is to be found in the "Dead-Water" of sailors.

The phenomenon of "Dead-Water," in which a sailing-vessel loses velocity and in a light wind may even come to a stop, and in which even a steamer may be retarded, has long been known to seamen. Probably the earliest notice of this is to be found in Chapter X. of the 'Agricola' of Tacitus, where,

in speaking of the geography of Britain, he says :—"Thule [Norway?] was also seen, previously hidden by snow and winter; but the sea is said to be *tough* and hard for the rowers and to be little stirred by winds."

Nansen, in his Norwegian North Polar Expedition (1893-1896), repeatedly noticed this phenomenon. On his return he turned over this problem to V. Walfrid Ekman for explanation. Ekman's paper may be found in the 'Scientific Results' of the expedition, volume v. (1904), and from it the following interesting data are taken.

In order to ascertain the prevalence of this phenomenon, Ekman published appeals for information in thirty-six foreign and in all available Scandinavian newspapers. From the former he received nine answers citing the appearance of "dead-water" in ten different localities, while from Scandinavian waters no less than thirty-two regions are reported to abound in this phenomenon. From this data Ekman concludes that "... From some reason or other it (dead-water) is comparatively seldom met with beyond Scandinavia or appears in a less decided manner than in the Norwegian Fjords."

Foreign reports give dead-water as occurring off Taimar Island on the coast of northern Silesia, also in Kara Sea and Bay in the same region, on the Murman coast of north-west Russia, as very "troublesome . . . off the great river mouths of South America," while off the mouth of the Orinoco a ship had to anchor to prevent drifting out of her course. This phenomenon is reported from the Gulf of Mexico and it has been experienced off the Baffin Bay coast of Labrador, while the Saint Lawrence mouth is designated by one Norwegian captain as one of the worst regions in the world for dead-water. Two circumstantial accounts are cited for this phenomenon off the mouth of Fraser River and another near Vancouver Island, in which localities it bears the familiar name used by Ekman. There are two reports of its occurrence in the mouth of the Congo, one for the mouth of the Loire River, and two for the Garonne River and the basin of Arcachon near Bordeaux.

These last instances, however, are not of such pronounced dead-water as in the following report of its occurrence not merely in the Mediterranean but between the island of Cerigo and the southern part of Greece. This very circumstantial account is, because of its pertinence to the Myth, given *verbatim* :—

"On January 2, 1858, we were between Cape Matapan and Cerigo and sailed eastward for the Archipelago. The

wind was W.N.W., a gentle breeze and water smooth. We had all sails set and made about  $3\frac{1}{2}$  knots. At 10 A.M., when we were about 12 naut. miles S.W. of Cerigo, the brig no longer answered her helm and began to go up northward to the wind. We worked the helm but to no avail. We backed the yards and shivered the braces and made all conceivable manœuvres, but the ship only turned a little and went back again. The little wind we had, seemed to be the same as before, and there were many ships in company both to port and starboard of us, which sailed away, whilst we were lying as if at anchor. Yet there was one sail about 3 miles to port of us in the same predicament.

"In this manner we lay for  $1\frac{1}{2}$  hours, when the ship began to glide and fall to leeward a little. We then got the head sails filled and had the aftersails shivering, and without any command of the helm the vessel got down into its course. The most remarkable thing was, however, that when I stood afore, I saw a long stripe stretching from the bow far over the water on each side dividing the water into two parts. The water around the ship was light gray, but ahead of the stripe it was wholly dark. These stripes seemed by and by to move aft . . . of course it was the ship that began to glide slowly onward . . . and after 5 or 6 minutes when the stripes had passed along the ship and had left the stern and the rudder, then, at that same moment, the ship again answered her helm and made head-way. The wind was about the same—W.N.W. by W. a gentle breeze. We made 3 knots, but no more, in the afternoon.

"When we approached Cerigo, the ship was about to get into dead-water again, but by working the rudder to and fro, we steered again, and after that, we did not feel the dead-water any more.

"The ship, during its long voyage, had become very dirty and overgrown with barnacles of 10 or 15 cm. in length, which may have had some effect."

From Ekman's quotations from his correspondents as to the occurrence of dead-water around Scandinavia, the following short excerpts are taken. In perusing them the reader is asked to bear in mind the very words of the quotations concerning the actions of ships found in the first section of this paper.

"The 'Fram' being in dead-water off Taimur Island . . . "It may therefore be supposed that the speed was reduced to about a fifth of what it would otherwise have been": and when steam was cut off at 100-150 metres from the buoy, the speed was so reduced that the engine had to be

started to reach it. "Sailing vessels may . . . be seen stuck fast in spite of a breeze brisk enough to keep the sails fully strained . . . . . Sometimes it happened that one vessel gets into dead-water and another not, though it is impossible to discover any reason for this." ". . . . . we already had good speed, when all at once the ship took dead-water' . . . she stopped so quickly that it looked as if she had dropped anchor." "The vessels being becalmed, "One of them was towed away without any difficulty, while the other, though of similar size, got into dead-water, and an extraordinary amount of work was required to get this vessel from the spot." Another ship in dead-water drifted back four miles with the current "against the direction of the steady fresh breeze, although they had all sails set." Another observer writes that in dead-water it ". . . feels as if something were fastened to the ship and holding it back." "In such cases, one or more vessels might suddenly lose their steering and remain on the spot, while others pass freely through the midst of them at a distance as short as two or three ships' length. After a while it was the turn of the other vessels to get into dead-water." "We scarcely glided along and were forced to have all sails set, until we were quite near our anchorage. Then the dead-water suddenly let go its hold. Believe me, they were both in a hurry, the ship and the pilot. Braces and falls ran a race together, and we only just got the anchor dropped without any misfortune." "The brig got into dead-water. . . . The speed was lost, and the ship was as if nailed to the spot." When the dead-water let go with the sails drawing, ". . . it all at once appeared as if the vessel had cut loose from a mooring aft." An 8-knot steamer in dead-water ". . . according to the pilot's own phrase, hardly moved from the spot."

Other descriptions might be quoted, but, save the one now to follow, these are the most typical. The one now to be given, with a sketch showing the appearance of the water around the vessel, is from the pen of Kommandor-kaptein Joh. Kroepelien of the Norwegian Navy. He writes that the ship with all sails set, heeling over rather stiffly before a fresh breeze ". . . . all of a sudden, lost her headway without any perceptible external cause, and the turning power of the rudder became nil.

"We then perceived that the ship had taken dead-water. From about amidships and outwards on both sides and to a considerable distance aft she was surrounded by a mass of dead-water, smooth as glass, as if the surface were covered with oil. The line between this smooth surface and the

water farther out, looked like boiling 'rips' and was quite distinct, the outer surface being strongly rippled by the breeze. The roar caused by the dead mass of water which, clinging to the ship, was dragged along through the water outside, was so loud that it might well have been deemed we were in the vicinity of a rapid. I do not remember the appearance of the wake, nor, I believe, was there anything remarkable about it. The rudder was of no use; we were forced to handle the ship by means of the sails and our two boats towing from the bow, and thus we proceeded at a speed of one or two knots.

"In this manner we went on for a couple of hours. All of a sudden, without any known cause, we were set free from the dead-water. The wind had been very steady the whole time, and we had constantly endeavored to keep the ship in the same course. After being freed from the dead-water the ship got headway, and after a while we logged 7 knots, going close to the wind."

Captain Kroepelien's sketch is reproduced herein as fig. 8 (Pl. XVII.). Concerning such an appearance as is here shown, Ekman writes: "As the boundary waves (to be described and explained later)\* follow the vessel, their wave crests and wave hollows remain in an invariable position relative to the vessel. If the wave motion gives to the water at a particular spot a velocity with the vessel, it would appear as though a bulk of water were being dragged along with her, although it is really always a new mass of water which follows the vessel for a short distance. It is exactly analogous to a boat sailing before the wind with just the same speed as the breaking waves at her side. In the case of dead-water, on the other hand, the illusion will be more complete, because the vessel moves at a slow velocity, and the waves causing the motion of the water are themselves not visible."

In perusing the foregoing accounts, the reader cannot have failed to be struck by the capriciousness of the phenomenon of dead-water, its sudden and seemingly inexplicable appearance, its equally sudden and mysterious disappearance. It may cause a ship gradually to lose speed, or suddenly to be stopped still as if "navigated," "moored," or "anchored" to the spot. The ship may gradually regain her speed or may suddenly speed away "as if a mooring had been cut." Again, a ship may fall into dead-water while a near neighbor but a few cable lengths away may sail on her course without "let or hindrance."

The instances just quoted, closely, almost precisely, parallel



the accounts from the old writers given in the first part of this paper, and there can be no doubt that their phenomena were *bona fide* occurrences of dead-water. One cannot wonder then that when a ship was thus checked and an *Echeneis* found, as it was not unlikely to be, sticking to rudder or hull, that the fish was deemed the cause of the checking of the speed of the vessel, and that the myth grew and became widespread.

Thus far we have been occupied with Ekman's accounts of dead-water, now let us consider his explanation of this strange phenomenon. After a study of some 42 accounts and descriptions, foreign and domestic, he generalizes as follows: ". . . I conclude that dead-water may occur in every place where fresh water flows out over the sea, but that for some reason or other it is comparatively seldom met with beyond Scandinavia or appears in a less decided manner than in the Norwegian fjords. . . . Dead-water only appears near to coasts, in those places where a suitable layer of fresh or brackish water rests upon the heavier sea-water. A vessel, moving in such a place at slight or moderate speed, may happen to feel the influence of this phenomenon; it is then said that the vessel has 'taken dead-water,' or 'got into dead-water.' It is a very troublesome matter indeed. A sailing vessel in this plight generally refuses to answer her helm and becomes unmanageable; steamers, at times sailing vessels also, keep their steerage, but nevertheless the dead-water is a great hindrance, causing the ship to lose her speed almost entirely. The 'Fram,' for instance, so generally capable of making 15 knots along the Siberian coast when heavily loaded, had her speed reduced to about one knot in dead-water."

Dead-water then appears to be due to a layer of fresh or brackish water resting upon the heavier sea-water. The greater the difference between the densities of the two layers of water, the stronger of the dead-water. A vessel sailing into such an area loses "way," refuses to obey her helm, and becomes unmanageable; even steamers have difficulty in maintaining speed, slow ones being greatly checked and at times brought almost to a standstill, while sailing-vessels may be completely stopped. This appears to be due to the fact that ". . . the vessel when moving at slow speeds generated large waves in the salt-water fresh-water boundary, and the resistance of these speeds was anomalously increased. At higher speeds, however, the waves disappeared and the resistance was not affected by the fresh-water layer."

Ekman tried many experiments in a large glass tank con-

taining a heavy bottom layer of salt water coloured with India ink, having on top of it an uncoloured layer of lighter fresh water. Through this fresh-water layer he towed with a constant or steadily increasing force a small boat model, and studied and even photographed the boundary waves set up in the fresh-water salt-water boundary. He likewise worked out the numerical results in a long series of extended and complex mathematical equations, and as a result of his experiments and calculations he states that: "It is proved by the theoretical and experimental investigation above, that a vessel moving in such a place creates waves in the boundary between the two water layers, and, that on this account, very marked effects on the speed of the vessel will occur: and it will be shown below that from the existence of such waves all essential effects and peculiarities of the dead-water phenomenon can be very simply explained . . . . . it will, in addition, be shown that the resistance and speed reduction due to the wave generation is of just the proper order of magnitude to explain the effects of dead-water; so that the correctness of the explanation may be regarded as completely substantiated"\*.

Fig. 9 (Pl. XVII.) is copied from Ekman's photographs showing how the retarding boundary wave is created and how it affects the vessel. Of these photographs Ekman himself writes: "The most important point, which the photographs described above clearly show is that the waves largely increase in height when the velocity of the boat increased toward the critical velocity, but when this is passed, and the boat is free from dead-water, the waves disappear." In this connection it should be noted that in (Ekman's) figures A, B, C, the boat is in dead-water with boundary waves steadily increasing in size. In D, however, the velocity of the boat has increased beyond the critical velocity and the boundary waves have disappeared . . . the boat is free from or without dead-water.

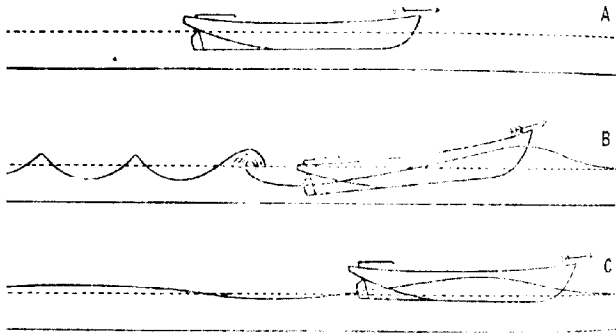
Fig. 10 (p. 304) is copied from Ekman from Scott-Russell (a distinguished English engineer of the middle of the 19th century) to show the effects of towing a boat in shallow water. Ekman uses it to explain the action of the boundary waves in dead-water. "At the lower velocity, the boat pushes a mass of water before her stem, and at her stern she provokes a wave-hollow; her resistance is in consequence increased

\* B. Holland-Hansen, in Sir John Murray and Dr. Johann Hjort's 'The Depths of the Sea' (1912), corroborated Ekman's conclusions, and, calling this wave a "boundary wave," says that it "may stop a ship so that it lies in dead-water hardly able to move at all."

just as if she constantly had to rise on an incline. She is then 'in dead-water.'" At the higher velocity on the other hand, the boat moves on top of a low hillock of water, which she provokes, and she consequently moves on a nearly horizontal surface, and meets with little resistance.

As to the *modus operandi* by which a vessel in dead-water regains her speed, Ekman takes the case of a sailing-vessel which has taken dead-water because of a drop in the wind. "If the wind now recovers its initial strength, the only effect is that the vessel has her velocity increased a little . . . . , but she still lies in dead-water and consumes her energy of propulsion upon large boundary waves. Only if the wind freshens still more, so that the propelling force

Fig. 10.



Diagrams from Scott-Russell, after Ekman.

- A, boat towed at low speed, no disturbance and no marked resistance; B, at the critical speed, boat tending constantly to rise on the "solitary wave" and meeting with great resistance; C, boat's speed exceeds the critical velocity, boat rides on top of solitary wave and meets with no resistance.

gets the better of the maximum resistance . . . . , is her velocity at once increased . . . . ; and the large boundary waves simultaneously disappear . . . . the vessel has got free from the dead-water."

One other explanation and we have finished with Ekman. It has been noted repeatedly that vessels in dead-water refuse to obey the helm. If now one turns to Capt. Kroepelien's account and to Ekman's interpretation given on page 301, the explanation is apparent. Boat, rudder, and the surface

layer of fresh water are all moving forward at the same rate. Little, if any, of the rudder reaches down into the underlying salt water, and hence the vessel loses steerage.

There is little else to be said concerning Ekman's claim to have explained dead-water. He had done so in a wonderfully clear and explicit manner. In his paper he refers to the Myth of the Echineis, and notes that the phenomenon of dead-water effectually clears it up. So it does, and another myth of the ancients is dissipated in thin air under the searching investigation of modern science.

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EXPLANATION OF THE PLATES.

PLATE XV.

- Fig. 1. Sucking-disk of Remora. After Jordan and Evermann, 1900.  
 Fig. 2. *Leptechensis naucrates*. After Jordan and Evermann, 1900.  
 Fig. 3. *Remora brachyptera*. After Jordan and Evermann, 1900.  
 Fig. 4. Echeiseis adhering to a vessel. After von Cuba, 1539.

PLATE XVI.

- Fig. 5. Imperato's "Echeisei, sev Remora," 1599, the earliest-known figure of scientific value.  
 Fig. 6. Aldrovandi's Remora, 1613.  
 Fig. 7. Sucking-fish attached to a shark. After Geare. Courtesy of 'Scientific American.'

PLATE XVII.

- Fig. 8. Kommandorkaptein Kroepelien's sketch of a vessel in "Dead-Water." After Ekman.  
 Fig. 9. Photographs (from the side) of 'Fram' model in experimental tank; fresh water coloured light, salt water dark. A, B, and C in dead-water with the towing-force gradually increasing; D at high speed, without dead-water.

XXX.—*The Ungual Phalanges termed Mylodon australis by Krefft, Spelean Animal vel Thylacoleo by Owen, and Thylacoleo by Lydekker.* By R. ETHERIDGE, JR., Director and Curator of the Australian Museum, Sydney, New South Wales.

[Plates XVIII.-XX.]

I. THE UNGUAL PHALANGES (*MYLODON AUSTRALIS*)  
 OF KREFFT.

When a name has crept into print and is in the course of time practically forgotten, or overlooked, as the case may be, it is only fair to the author thereof to resuscitate it, if found to be stable and of value. On the other hand, if established under a misconception, and found to be of no value, it were better relegated to the limbo of synonymy, or the society of abolished names.

There are several such names in the early annals of Australian Palæontology, and in the present paper I purpose dealing with the name *Mylodon australis*, Krefft, and the objects it represents.

Mr. Gerard Krefft, a former Curator of the Australian Museum, referred to his *M. australis* on, at least, four separate occasions. The first reference I have been able to light upon is contained in one of our Museum publications—'Guide to the Australian Fossil Remains exhibited by the Trustees of the Australian Museum, and arranged and named by Gerard Krefft,' &c.\*, wherein we read :—

"Order E D E N T A T A.

"Genus MYLODON ?

"*Myiodon ? australis*, Krefft.

"The presence of some animal, allied to the above extinct American genus, is indicated by a single terminal phalanx, or nail-bone, with its peculiar protecting bone, partly broken" †. This phalanx was obtained from the ossiferous deposit of the celebrated Wellington Caves, New South Wales.

The second reference appeared in Krefft's 'Australian Vertebrata—Fossil and Recent' ‡, as follows :—

"E D E N T A T A.—Sloth Tribe.

"MYLODON.

"*Myiodon ? australis*,"

with similar remarks to those already quoted. This phalanx must have come into Krefft's possession between 1867 and 1870, because there is no mention made of it in the first edition of the 'Australian Vertebrata' §.

The third reference is of a controversial nature, and is contained in "A Cuvierian Principle in Palæontology tested by evidences of an Extinct Leonine Marsupial (*Thylacoleo carnifer*), by Professor Owen, &c. Reviewed by Gerard Krefft," &c. ¶. Confining our attention to that portion of

\* Pp. 15, 8vo, Sydney, 1870.

† *Ibid.* p. 4.

‡ 'Industrial Progress of New South Wales,' pt. iii. 1871, p. 715.

§ Krefft, "Australian Vertebrata (Recent and Fossil), representing all the Genera known up to the present time. With Notes by Gerard Krefft." Cat. Nat. and Industrial Prods. N.S. Wales, sent to the Paris Universal Exhibition of 1867, by the New South Wales Commissioners (8vo. Sydney, 1867.—By Authority), pp. 91-110.

¶ Krefft, Ann. & Mag. Nat. Hist. (4) x. 1872, pp. 160-182, pls. xi. & xii.

this paper strictly dealing with the matter under consideration, we find Mr. Krefft writing as follows:—"The claw to which I more particularly refer as being that of a 'megatheroid animal,' and which, with its next joint, is deposited in the Australian Museum . . . is what I stated it to be—"the ungual or terminal phalanx of a creature allied to *Mylodon*." The upper face of the sheath is naturally open; and the next joint is short and thick, like some of the phalanges of Professor Owen's *Mylodon*. . . . I only draw attention to the probability that there were in olden times, as at the present day, small Edentata as well as large ones; and as I first discovered the presence of fossil edentate Monotremes in this country, I may be allowed to say, with the evidence before me, that animals allied to the *Mylodon* will yet be found" \*.

Before proceeding to consider Krefft's fourth reference it is necessary to ascertain what Sir Richard Owen said of these terminal phalanges. It appears photographs were sent to Owen by Krefft, but how many and whether or no with the latter's *Mylodon* name attached there is no evidence to show. "Amongst the fossils obtained by Professor (A. M.) Thomson and Mr. Krefft from the breccia-caves of Wellington Valley, were several ungual phalanges, some of which, equalling or surpassing those of a lion, were compressed, the vertical exceeding the transverse diameter, and being considerable in proportion to the length: these phalanges are curved and pointed, but the point is more or less blunted or broken, apparently after interment. They support a claw, and in most there are traces more or less plainly discernible of a bony sheath † which bound or strengthened the attachment of the base of the claw."

Owen then described the bones separately and continued:—"From these specimens may be inferred a spelæan animal with subcompressed decurved pointed claws, equalling or exceeding those of the Lion or Tiger in size, but supported by phalanges resembling those of *Thylacinus*, *Dasyurus*, and the *Opоссums* in being non-retractile, or wanting the characteristic low position of the joint in the sheathed claw-bones of placental Felines, but resembling these phalanges, rather than the non-contractile ones of the marsupials above mentioned, in the proportion of depth to length and breadth." And finally:—"No evidence of a Megatheroid or other Edentate animal has been found from any cave or

\* Krefft, *ibid.* pp. 180-181.

† So far as I can gather only one exhibited this.



fossiliferous deposit in Australia. The shape of the ungual phalanges in Kangaroos and Wombats is known. The ungual phalanges ('Extinct Mammals,' pl. x. figs. 11-14) are too small for *Nototherium* and *Diprotodon*, if even one were to entertain the idea of those huge Marsupial Herbivora having had sheathed, compressed, decurved, pointed claws like those which the phalanges in question plainly bore. These phalanges are as much too large for the *Thylacinus* and *Sarcophilus* \*. But there is no other associated Carnivore corresponding in size with that of the animal indicated by them, save the *Thylacoleo*."

Krefft for the fourth time published his name and had figures prepared, the latter having a curious history. It appears that Owen, in 1867, proposed to the New South Wales Government "a careful and systematic exploration of the limestone caves of Wellington Valley," no doubt led thereto by his recollection of the discoveries made at Wellington by his old friend the Surveyor-General (Sir Thomas Livingstone Mitchell). This suggestion was adopted, and Krefft was placed in charge of the work; ultimately added to it was a similar exploration of the "Rivers of New South Wales." This exploration dawdled on until the early part of 1882, long after Krefft had ceased his connection therewith. A full account of all that took place during these fifteen years will be found in the N.S. Wales 'Votes and Proceedings' †, under the title, "Exploration of the Caves and Rivers of New South Wales (Minutes, Reports, Correspondence, Accounts)." The only portions of any scientific value are the reports of Messrs. Thomson and Krefft. In the latter's principal report, dated May 1870, the following appeared:—

"Order — ?

"*Myiodon? australis* (Krefft).

"A distal or ungual phalanx of some unknown animal, resembling the same bone of a *Myiodon* (the distal phalanx of the pollex).

"The specimen referred to is quite unique, and proves the existence in Australia of a large sloth not unlike the

\* Owen, Phil. Trans. 1871, pt. i. pp. 262-63, pl. xiii. figs. 11-14. It may be well to state at once, and definitely, that Owen's "ungual phalanges" comprised two entirely different types of nail-bones; this will be made abundantly clear in the sequel.

† Krefft, 'Votes and Proceedings,' v. 1882, pp. 551-602 (pls. 14 numbered and 17 unnumbered).

South American genus *Myiodon*; the size of the bone is about 1 inch and 2 lines in length. Another much smaller distal phalanx, also covered by a 'hood' is in the collection, but this belongs evidently to either a dog or cat-like creature" \*.

Krefft gave three figures of the largest of these phalanges in one of the numbered plates of the 'Caves and Rivers Report' (pl. 14, figs. 7-9). It appears that about 1870 he contemplated the publication of a work on 'Australian Fossil Mammals,' for which the seventeen numbered plates were prepared. But, as he explained elsewhere †, these plates "for want of funds were not published at the time," but in 1882 were appended to the Parliamentary "paper" referred to.

The MS. relating to these plates is preserved in the Mitchell Library, Sydney, and the explanation of figs. 7-9 reads as follows:—"Are distal phalanges or nail-bones of a very peculiar animal allied to the American genus *Myiodon*. It is impossible to say what kind of teeth the creature had judging from these two bones only. They probably resembled those of a Wombat."

One other reference will complete my knowledge of the history of *Myiodon* (?) *australis*, Krefft.

In the 'Catalogue of the Fossil Mammalia in the British Museum,' pt. v. 1887, Mr. R. Lydekker, in the list of *Thylacoleo* remains, records the cast of an ungual phalangeal with the remark, "the bone was evidently covered by a horny claw, like that of *Phalangista*" ‡. Now the point is this, the Owen hooded phalangeal of *Thylacoleo*, is *not* the Lydekker phalangeal of *Thylacoleo*, but the unsheathed bones of both Owen and Krefft are the latter.

What Mr. Krefft's views of the affinity of his fossils may have been after September 1872, I have no precise means of knowing, but I do not suppose any alteration took place, as he appears to have been obsessed with the Edentate affinity of his fossils, and always maintained his own opinions with great pertinacity.

In the photographs supplied to Prof. Owen and published in the 'Philosophical Transactions,' 1871, Owen's figs. 11 and 12 on pl. xiii. are the equivalents of Krefft's pl. 14, figs. 7-9 of the 'Caves and Rivers Report,' in the first instance two, and in the second three views of one and the same

\* Krefft, *loc. cit.* p. 55<sup>2</sup>; both are identically the same.

† Krefft, *Ann. & Mag. Nat. Hist.* (4) x. 1872, p. 172.

‡ Lydekker, *loc. cit.* p. 195.

specimen, still in the Australian Museum. Sir Richard, unfortunately, interchanged the numbers of two of his illustrations between the letter-press descriptions (p. 262) and the figure numbers on his pl. xiii. thus :—

For pl. xiii., fig. 12 read fig. 13.

” ” ” 13 ” ” 12.

In his ‘Researches on the Fossil Remains of the Extinct Mammals of Australia,’ &c. (1877) another interchange was made, thus :—

For pl. x. fig. 11 read pl. ix. fig. 12.

” ” ” 12 ” ” ” 13.

There remains the smaller “distal phalanx” referred to by Krefft in the ‘Caves and Rivers Report.’ This specimen is 20 mm. long by 14 mm. in breadth, inclusive of the sheath or hood, which is complete proximally, but broken away towards the distal end of the bone. It is similar in shape to the nail-bone called *Mylodon* by Krefft, but with a greater degree of curvature, and less size. The articular surface, just as in that previously referred to, occupies nearly the whole of the proximal end, and is divided into two subarticular surfaces by a median longitudinal ridge for adaption to the convexities at the distal end of the penultimate phalanx. The tuberos process for the flexor tendon attachment is remarkably prominent and stout in comparison to the size of the entire phalanx : on the plantar surface of this tuberosity are the two arterial foramina. Krefft considered this to belong “to either a dog or cat-like creature.”

With this last exception such are the phalanges described by Krefft as *Mylodon australis*, a supposed Australian Edentate, and referred by Owen to his *Thylacoleo carnifex* by deduction. In considering the affinity of these bones, the following general conclusions may, I think, be fairly arrived at :—

1. The law of probabilities is decidedly adverse to Krefft's view. Had an Edentate existed in Australia in Post-Tertiary times, some more definite trace would have been met with ere this.
2. A right calcaneum, referred to this genus by Lydekker, is all we know of the feet of *Thylacoleo*, and this determination is problematical\*.

\* Lydekker, *loc. cit.* p. 195.

3. The reference of Krefft's *Myiodon* phalanges to *Thylacoleo* on the part of Owen was purely "conjectural" (to use his own expression), but at the same time a clever piece of deduction based on his view of the carnivorous habits of the "Marsupial Lion."
4. If we accept for the time being, the phalanges called *Myiodon? australis* as those of *Thylacoleo*, such acceptance will not in the least strengthen the views held either by Owen on the one hand, or Flower and his followers on the other, as to the gastronomical habits of *Thylacoleo*, hooded phalanges occurring amongst both herbivorous and carnivorous animals.
5. As possibly referable to *Thylacoleo* Owen figured two entirely distinct types of ungual phalanges.

We are now acquainted with the pedal bones of *Diprotodon* through the researches of Prof. E. C. Stirling, and it can be legitimately surmised that those of its second cousins *Nototherium* and *Euowenia* were similar. None of the Macropodidae can put in a claim: amongst the flesh-eaters, *Sarcophilus* and *Thylacinus*, and the *Dasyures*, with the non-marsupial *Warrigal*, the osteological structure is too well known to require comment.

Finally, in all probability, although "conjectural" Owen's view of the nature of the hooded nail (eliminating those without a sheath) bones will in the long run prove to be correct; reduction of other genera by elimination supports it. If such be the case, then what is the claw referred to *Thylacoleo* by Lydekker? This will be investigated immediately.

The following is the synonymic bibliography of Krefft's ungual phalanges:—

- Myiodon? australis*, Krefft, Guide Austr. Foss. Remains, 1870, p. 4.  
 „ *australis*, Krefft, Austr. Vert. Foss. & Recent (Industrial Progress of New South Wales), 1871, p. 715.  
*Spelean Animal* or *Unguiculate Mammal*, Owen (pars), Phil. Trans. 1871, pt. i. pp. 262, 263, pl. xiii. figs. 11-12 (non 13, 14).  
*Megatheroid Animal*, Krefft, Ann. & Mag. Nat. Hist. (4) x. 1872, p. 180.  
*Spelean Animal . . . Thylacoleo*, Owen, Foss. Remains Extinct Mamm. Austr. i. 1877, pp. 182-183, ii. pl. ix. figs. 11-12.

*Myiodon? australis*, Krefft, N. S. Wales Votes & Proceedings, v. 1882, p. 558, 14th numbered pl., figs. 7-9.

## II. THE UNGUAL PHALANX PROVISIONALLY CATALOGUED AS *THYLACOLEO* BY LYDEKKER.

Many years ago a plaster replica of another of Krefft's specimens\*, described in MS. as the "nail-bone of the hind foot of a gigantic Phalanger, probably a small *Zygomaturus*, *Natotherium*, or *Diprotodon*" was forwarded to the Geological Department of the British Museum (Natural History). I surmised this might be No. M. 1523† of the 'British Museum Catalogue of Fossil Mammals,' part v. (p. 195) catalogued by Lydekker as "cast of an ungual phalangeal" provisionally of *Thylacoleo*; by correspondence Dr. A. S. Woodward confirmed this. The original bone is preserved here and is slightly imperfect; it is from the Wellington Caves, and bears the number A. 13320 (Pl. XVIII. fig. 2). It is manifest, if the sheathed nail-bones ("*Myiodon*") are referable to *Thylacoleo*, following Owen, such an arched, laterally compressed and naked bone, one of those spoken of by Krefft as "large nail-bones . . . evidently those of a Phalanger"‡, cannot. One of these§ is probably the original of both Owen's illustrations of his non-sheathed *Thylacoleo* ungual phalangeal. Our collection contains five of these bones, four from the Wellington Caves ossiferous breccia (Pls. XVIII.-XIX. figs. 2-9), the fifth from Cope's Creek, probably from a thermal mud-spring deposit (Pl. XX. figs. 10-12). These vary much in size and degree of dorsal curvature, and for the convenience of description may be taken separately.

*Type 1.*—The phalanx in question || (Pl. XIX. figs. 8 & 9) is highly arched, compressed laterally, the dorsal edge thin, sharp (trenchant), the degree of curvature almost equal to the quadrant of a circle, the general appearance of the bone being decidedly hook-like. The proximal end is imperfect, the articular surface and the plantar tuberosity gone; it is 35 mm. wide, and in thickness 8 mm.

The second example never seen by Krefft or Owen (Pl. XX. figs. 10-12) is a more perfect specimen, one in

\* Krefft, 'Caves and Rivers Report,' pl. 14 (numbered), fig. 12.

† Dr. A. S. Woodward informs me this should read 1526.

‡ Krefft, *loc. cit.* pl. 14. (numbered), figs. 11 and 12.

§ Krefft, *loc. cit.* MS. description of pl. 14. fig. 11.

|| Krefft, *loc. cit.* pl. 14. (numbered), fig. 2.

which the proximal articular surfaces, allowing for wear and tear, are perfect. The lateral surfaces (at the point of disruption in Pl. XIX. figs. 8 & 9) suddenly bulge outwards to form an expanded proximal end with a concave articular surface divided by a longitudinal central ridge, and below a very strong and comparatively large cushion for the attachment of the flexor tendon. Immediately above the centre of the tendon tuberosity on either side, are the foramina of the digital arteries. The surface of both specimens is pitted and roughened.

Length of complete bone 51 mm.; breadth 45 mm. approximately; thickness 13 mm.

*Type 2.*—The phalanges of the second type (Pls. XVIII.-XIX. figs. 2-7) differ from those of the first by a greater length in proportion to width, a much less arched dorsal edge, and a slightly less lateral compression, otherwise the same features characterize both. The following are the dimensions of the largest:—

Length 45 mm.; breadth 29 mm.; thickness 11 mm.

In the sheathed, or hooded terminals of Owen, although the nail-bone is compressed laterally (Pl. XVIII. fig. 1) the dorsal edge is only sharp or trenchant distally, the proximal end is truncate-flattened forming an elongately triangular surface. The articular surface for union with the distal end of the penultimate digit is highly concave, and much overhung above, as figured both by Owen and Krefft. The sheath is one with the core, or nail-bone, at the proximal end around the articular concavity, and along the plantar surface as far as it extends; the tuberosity is to some extent flattened. The arterial foramina pierce the sheath through the plantar surface of the tendon tuberosity, and then appear to enter the nail-bone as in the preceding type. Immediately below the dorsal truncate surface at the proximal end are two other arterial foramina.

Now, to what type of Marsupial do these ungual phalanges (Pls. XVIII.-XX. figs. 2-12) belong? It will be more satisfactory to consider Types 1 and 2 separately. Type 1 (Pls. XIX.-XX. figs. 8-12) is the "nail-bone of a gigantic Phalanger of Krefft," but this form appears to have been quite unknown to Owen. In the Macropodidæ the nail-bones are elongate, non-trenchant, more or less oval in section, and very freely arched, if at all. The nail-bones of the Peramelidæ are double, more or less circular, and non-trenchant. In the Phascologyidæ, or Wombats, these terminals are again rounded above, roughly oval in section, and not hooked. The nail-bones of the Diprotodontidæ,

guided by Prof. E. C. Stirling's reconstruction of *Diprotodon*, resemble to some extent those of the Kangaroos, plano-convex, slightly curved, broad plantar surface, and the proximal concavities occupying the whole articular surface, instead of about two-thirds as in Types 1 and 2; moreover, the position of the foramina of the plantar artery branches is markedly different. What is true of the nail-bones of *Diprotodon* is possibly equally true of those of *Nototherium* and *Euowenia*.

There remain the Dasyuridæ and Phalangeridæ. In the first, taking the Tasmanian Wolf (*Thylacinus cynocephalus*, Harris) as an example, the nail-bones are long, more or less oval in section, rapidly decreasing in size from the proximal to the pointed distal end. The latter are more particularly accentuated in the Tasmanian Devil (*Sarcophilus ursinus*, Harris, Pl. XIX. fig. 14), in which the distal ends of these nail-cores are to all intents and purposes, acicular; hence, I dismiss the Dasyuridæ from consideration.

This reduces comparison to the Phalangeridæ, the family in which Krefft placed\* these remains. The resemblance of the large complete specimen (Pl. XX. figs. 10-12) from Cope's Creek to similar bones of some members of this family is very striking. For the purpose of comparison I have selected two, the Great Flying Phalanger (*Petauroides volans*, Kerr) and the Koala, or "Native Bear" (*Phascolarctos cinereus*, Goldfuss) †. In the Flying Phalanger it is the 4th and 5th digits which terminate in nail-bones so remarkably like the Cope's Creek fossil (Pl. XX. figs. 10-12), but in the Koala the resemblance is not so strong (Pl. XIX. fig. 13), in consequence of the much greater length in proportion to width; this, however, only partially holds good for the pollices ‡. With these facts before me I can come to no other conclusion than that the subjects of Pls. XIX.-XX. figs. 8-12 are the terminal phalanges of an enormous Phalanger, following Krefft in this opinion, but in a more restricted sense than he employed the term.

We may now pass to the second type (Pls. XVIII.-XIX. figs. 2-7). The two specimens are Krefft's "large nail-bones

\* Bearing in mind that Krefft included *Diprotodon*, &c., in this family.

† One fact in connection with the terminal phalanges, or nail-bones, of the Phalangers in general is very obvious, the stouter and stranger build of those of the fore feet, accompanied with a greater degree of curvature.

‡ One of the most noticeable features in Type 1 is the remarkable slab-sided, or straight-walled appearance.

... evidently those of Phalangers," and one (Pl. XVIII. fig. 5) is Owen's *Thylacoleo* "ungual phalangeal" (his fig. 13) and Lydekker's *Thylacoleo* "ungual phalangeal." By the same method of elimination as observed in the case of Type 1, I reduce consideration in this instance to the Phalangeridæ alone. There is no greater degree of variation between Types 1 and 2 than there is in the forms of the terminals of the same foot of many species of Phalangeridæ. I, therefore, again support Krefft's views of the affinity of these bones, but to what genus of the family the animal possessing them was most nearly allied only time can prove. For my own part I am rather in favour of a gigantic Koala.

The following table explains the relative identity of the various figures referred to:—

Krefft's figs. Austr. Foss. Remains.	Owen's figs. Phil. Trans. 1871 (1872).	Owen's figs. Extinct Mamm. of Australia.	Present figs.
Pl. 14, fig. 2.	.....	.....	Figs. 8 & 9.
" " 7.	.....	.....	.....
" " 8. Pl. xiii. figs. 11 & 12.	.....	Pl. ix. figs. 11 & 12.	Fig. 1.
" " 9.	.....	.....	.....
" " 11. ? Pl. xiii. figs. 13 & 14.	.....	? Pl. ix. figs. 13 & 14.	? Figs. 5-7.
* " " 12.	.....	.....	Figs. 2-4.

In these notes I have sought to show that:—

1. Owen figured as the possible ungual phalanges of *Thylacoleo* two entirely distinct nail-bones—a "hooded" form, and an unhooded or unsheathed one; both cannot belong to the same kind of animal.

2. If the hooded bone be accepted for the time being as of *Thylacoleo*, then the bone catalogued as "cast of an ungual phalangeal" by Lydekker cannot possibly be so.

3. The non-sheathed terminals (Types 1 and 2) were never claimed by Krefft as appertaining either to his *Mytilodon australis*, or to *Thylacoleo*.

4. *Thylacoleo* is regarded by the advocates of its herbivorous nature as a member of the Phalangeridæ. If it be so, then the phalanges of Types 1 and 2 may, perhaps, be those of it.

5. If the suggestion contained in the last paragraph should

\* This is the original of the replica called by Lydekker *Thylacoleo* (A.M. 13320, B.M. 1528 (30)).



prove correct, it follows that the identity of the hooded bones ("*Myiodon australis*") has yet to be discovered.

The suggestion of an extinct Koala may possibly be not so speculative as would at first sight appear when it is remembered that Mr. C. W. de Vis described\* a portion of a fibula that he believed represented "a progenitor of the Koala." The further discovery of a premaxillary with its palatal process was held to strengthen this view. Said Mr. de Vis:—"The Koala, or Native Bear, is now one of the few types of Australian life which has not been recognized as a part of its ancient economy: yet it is one of which no one could be surprised to find an ancestral form among the past modifications of marsupial structure." He proposed to distinguish the former owner of this fibula by the name of *Koalemus ingens*. Portion of a shoulder-blade was referred to another extinct Pha'anger (*Archizonurus securus*).

#### EXPLANATION OF THE PLATES.

- Fig. 1. The original of Krefft's "ungual or terminal phalanx of a creature allied to *Myiodon*," with "its peculiar protecting bone partly broken." The original of Krefft's figs. 7 and 8, and Owen's 11 and 12. Wellington Caves.  $\times 2$  diam.
- Fig. 2. Ungual phalange "equalling or surpassing those of a Lion" (Owen). This is the original of Krefft's fig. 12, and Lydekker's Catalogue (M. 1526 (36)). Wellington Caves.  $\times 2$  diam.
- Fig. 3. Dorsal view of the bone, fig. 2.  $\times 2$  diam.
- Fig. 4. Plantar " " "
- Fig. 5. Another phalange similar to Fig. 2, but with the dorsal surface straight, or even a little concave. This is probably the original of Owen's figs. 13, 14. Wellington Caves.  $\times 2$  diam.
- Fig. 6. Dorsal view of fig. 5.  $\times 2$  diam.
- Fig. 7. Plantar " " "
- Fig. 8. Highly compressed ungual phalange with the proximal portion broken away. Original of Krefft's fig. 2. Wellington Caves.  $\times 2$  diam.
- Fig. 9. Dorsal view of fig. 8.
- Fig. 10. Probably the almost perfect condition of an ungual phalange similar to that seen in fig. 8. Cope's Creek.  $\times 2$  diam.
- Fig. 11. Plantar view of fig. 10.  $\times 2$  diam.
- Fig. 12. Dorsal " " "
- Fig. 13. *Phascogalea cinereus*, Goldfuss. Ungual phalanx of the right fore foot.
- Fig. 14. *Sarcophilus ursinus*, Harris. Fourth ungual phalanx of right fore foot.

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\* De Vis, 'On the Phalangistidae of the Post-Tertiary Period in Queensland,' Proc. R. Soc. Queensland, vi. pts. ii. & iii. p. 100.

XXXI.—Notes on Myriapoda.—XII.\* *A Preliminary List for Derbyshire, with a Description of Brachychaeteuma quantum, sp. n., and Chordeumella scutellare bagnalli, var. n.* By HILDA K. BRADE-BIRKS, M.Sc., M.B., Ch.B., L.R.C.P., M.R.C.S., and the Rev. S. GRAHAM BRADE-BIRKS, M.Sc.

### I. INTRODUCTION.

A short holiday in Derbyshire at the end of May and beginning of June 1918 gave us an opportunity to collect some centipedes and millipedes; and we feel that the results are of sufficient interest to warrant the publication of a preliminary list for the county, so arranged as to make mention of some of the work previously done by other collectors as well as to include our own 1918 records. Also, in September 1916, we made one excursion from the Staffordshire side to the Derbyshire-Staffordshire boundary near Bercsford Hall; and, although there was some confusion in our minds as to the exact position of the boundary, we have incorporated some relevant results of that day's work in the present paper, recording the specimens taken there as from "near the R. Dove," because we are practically certain that these are truly Derbyshire occurrences. If we are in error about the county, the animals thus recorded were found close to the boundary of the shires, but on the Staffordshire side. Two species included under these circumstances in the present list, viz. *Polydesmus denticulatus* and *Scolopanes acuminatus*, are not otherwise known to us from Derbyshire.

In several cases of material placed at our disposal by Mr. Standen, Mill Dale (Staffordshire) is included in our detailed records, because it is coupled as a collecting-ground with Dove Dale (Derbyshire); but in no case does such an occurrence stand alone as a county record.

In the Diplopoda and Chilopoda (with which this paper deals) we now know some thirty-one Derbyshire forms, and these are enumerated below:—

#### DIPLOPODA (= Millipedes).

1. *Glomeris marginata* (Villers).
2. *G. marginata perplexa*, Latzel.
3. *Tulus ligulifer*, Latzel & Verhoeff.

\* A previous paper in this series—the fifth—appeared in this Journal, May 1917, ser. 8, vol. xix. p. 417.

4. *I. (Ophiulus) fallax*, Meinert.
5. *I. (Tachypodius) albipes*, C. L. Koch.
6. *I. (Cylindroiulus) silvarum*, Meinert.
7. *I. (Cylindroiulus) britannicus*, Verhoeff.
8. *Schizophyllum sabulosum* (Linné).
9. *Trichoblanulus guttulatus* (Bosc).
10. *Amsteinia fuscus* (Am Stein).
11. *Polydesmus complanatus* (Linné).
12. *P. corticeus*, Porat.
13. *P. denticulatus*, C. L. Koch.
14. *Brachydesmus superus mosellanus*, Verhoeff.
15. *Ophiodesmus albanus* (Latzel).
16. *Brachychaetuma quartum*, sp. n.
17. *Polymicrodon latzeli* (Verhoeff).
18. *Chordeumella scutellare bagualli*, var. n.

## CHILOPODA (=Centipedes).

19. *Lithobius forficatus* (Linné).
20. *L. variegatus*, Leach & Brolemann.
21. *L. melanops*, Newport.
22. *L. crassipes*, L. Koch.
23. *L. dubosqui*, Brolemann.
24. *Cryptops hortensis*, Leach.
25. *Geophilus carphophagus*, Leach.
26. *G. longicornis*, Leach.
27. *G. inaequalis*, Attems.
28. *G. electricus* (Linné).
29. *Brachygeophilus truncorum* (Bergsøe & Meinert).
30. *Stigmatopaster subterraneus* (Leach).
31. *Scutigerella acuminatus* (Leach).

The nomenclature in the two classes is difficult, especially the nomenclature of genera and subgenera, and, as there is difference of opinion amongst the leading authorities, it cannot be claimed that there is finality about all the names we have used in the foregoing list, nor by using these do we wish to infer that we have refused to consider the claims to priority of others. The fact is that we have not yet had the opportunity to consider all the complicated evidence involved in the question of some of these generic and subgeneric names.

In the detailed records in the second section of this paper other collectors' names are cited by initials, as follows:—

Mrs. Furness, *A. W. F.*; Mr. J. Wilfrid Jackson, *J. W. J.*; Mr. R. Standen, *R. S.*; Mr. C. R. Brown, *C. R. B.*; Mr. William Boulsover, *W. B.*

To each of these we offer our best thanks.

An asterisk indicates that the material forms a part of Mr. R. Standen's collection. When a record is followed by the letter *G.* and a number, the material is so registered at the Manchester Museum. The letter *J.* in brackets, after a

record, indicates that the identification is that of our friend Captain A. Randell Jackson, M.C., M.D., D.Sc., R.A.M.C.

In the section of the paper which deals with detailed records we have introduced a few diagnostic points which may be of value to other naturalists.

#### *Geological Considerations, etc.*

As far as our own 1918 collecting in the county is concerned, we worked in two areas, both of them predominantly limestone (Carboniferous Limestone) regions. The one was the Buxton neighbourhood, where Burbage was our centre, and where all our collecting was on the limestone, and the other was mostly in the limestone triangle roughly formed by Bakewell, Ashford, and Great Longstone; this area is indicated in the present paper as "Bakewell district," except where more explicit details are given—as, for example, in describing the occurrence of the new animals. One of us (S. G. B.-B.) accompanied the veteran local naturalist and antiquarian, Mr. William Boulsover, of Bakewell, on one excursion to Manners Wood, which stands out on a sandstone (Yoredale Series) ridge close to the town of Bakewell; the collecting done there is clearly indicated in the body of the records, but it may be noted that, in one short visit, *Lithobius variegatus* was taken there, although the writers did not meet with it in either of the limestone areas, one near by, on the occasion of their 1918 (May-June) collecting. The distribution of this species, which is the only centipede on our British list which is unknown outside the British Isles, is extremely interesting, and worthy of careful study, in which natural factors, including altitude, vegetation, and geological features should certainly be taken into account.

It may be added that the junction between the Carboniferous Limestone and the Yoredale Rocks in the neighbourhood of the Derbyshire-Staffordshire boundary, where we collected in September 1916, is near the county boundary in that area, the Derbyshire side being the border of an extensive limestone region.

#### *Cave Hunting.*

During our stay in the Bakewell district we made one excursion through Monsal Dale to Cresbrook with Mr. J. R. Widdowson to visit a cave in the limestone at Barmyewick, but, after all, we were not successful in finding any myriapods there. Some good results are to be expected from

a proper exploration of our English caves, and this note may serve as a reminder to naturalists who visit caves for the purpose of studying other branches of science.

## II. DETAILED RECORDS<sup>1</sup>.

### Class *DIPLOPODA*.

#### Subclass *CHILOGNATHA*.

#### Family *Glomeridæ*, Leach, 1814.

#### Subfamily *Glomerinæ*, Verhoeff, 1910.

#### Genus *GLOMERIS*, Latreille et Leach.

##### 1. *G. marginata* (Villers, 1789).

10-20 mm.

This is the common pill-millipede. It is black dorsally, but the pleurotergites are edged with white.

\*Cave Dale, *R. S.*, in a recent year (*J.*), *G.* 3143; \*Castleton, *R. S.*, vi. 13; \*Dove Dale, *R. S.*, *J. W. J.*, *C. R. B.*, 25 v. 16; near the R. Dove, ourselves, 1916; Bakewell district, ourselves, 1918; one example, Manners Wood, near Bakewell, *W. B. & S. G. B.-B.*, 6 vi. 18.

In addition to the above examples we have examined specimens from Millers Dale which do not appear to be typical. In spirit-specimens the dorsal surface of the body exhibits a row of light spots on either side of the middle line, due to the fact that the lateral parts of each pleurotergite are marked by definite light oval areas. The dimensions are the same as those of the typical form. We think it inadvisable, however, to establish a new variety on the material at our disposal until, at any rate, we have made a detailed study of the English representatives of the genus.

Seven examples, Millers Dale, *R. S.*, 17/vi. 17.

*Types*. 1302, Brade-Birks collection.

##### 2. *G. marginata perplexa*, Latzel.

6.5 mm.

At present we think it advisable to treat this form as of subspecific rank. Mr. Bagnall says (1) of this animal, "I cannot think that it can be a form of *marginata*, and *concord*

<sup>1</sup> The typical length of the species is given in each case as a guide to those interested in the group. Where the dimensions are not our own, we are indebted to various authors.

is unknown in our Islands; a study of British examples may show it to be a distinct species."

We have not yet been able to make a careful study of the genus *Glomeris*, but we may add that the animal in question is smaller than *G. marginata marginata*, although it has the white edges of the pleurotergites as in that form. Its general body-colour is brown, and its dorsal surface is furnished with four longitudinal rows of light spots. Two rows are distinctly lateral, while two are close to the median line. These more median rows are formed by a pair of spots on each pleurotergite, which tend to coalesce anteriorly and form a V-shaped marking on each segment. These more median rows alone are continued on to the last segment. Professor Ribaut has recorded the animal (10) under the name of *G. connexa perplexa*, Latzel; Dr. Verhoeff, on the other hand, records it (13) as *G. marginata perplexa*, Latzel, and adds a note of which the following is a rough translation:—"Recent investigations have shown me that *perplexa* and *marginata* belong to the same species, but not to *connexa*; I shall reconsider this point more carefully in another paper." We are not familiar with any later note by Verhoeff on this subject.

\*One specimen junior, Castleton, R. S., vi. 13.

#### Family Iulidæ, Leach (ex p.), 1814.

(Genus IULUS (s. l.), Brandt, 1833.)

#### Genus IULUS, Brandt.

#### 3. *I. ligulifer*, Latzel and Verhoeff.

Syn. *I. scandinavicus*, Latzel.

15-35 mm.

Verhoeff (13) includes this species in the subgenus *Microphidulus*.

The females of this species are very like those of *I. fallax*. The coxite of the second leg of the male, however, bears an oval expansion, which serves to characterize *I. ligulifer*.

1 ♂, 2 ♀, Buxton district, ourselves, 1918.

#### 4. *I. (Ophiulus) fallax*, Meinert, 1868.

Syn. *I. longabo*, C. L. Koch, 1847.

♂ 18-32, ♀ 25-45 mm.

A fair-sized black iulid, very like *I. ligulifer*, the females being practically indistinguishable from those of that species.

Both animals have an acute caudal process and smooth pronotites. In *I. fallax* the legs of the first pair, in the male, are sickle-shaped.

\*1 ♀ (or *I. ligulifer*), Cave Dale, R. S., in a recent year (*J.*), G. 3159; both sexes, Bakewell district, ourselves, 1918.

#### Genus TACHYPODOULUS.

##### 5. *T. albipes* (C. L. Koch).

Syn. ? *I. niger*, Leach.  
*I. transcraosulcatus*, Am Stein.

♂ 22-30, ♀ 25-35 mm.

This large black julid is easily distinguishable under the microscope by the presence of transverse striae on the pronotites, to which Am Stein's name for the species owes its origin. This animal is common in our islands.

\*♀, Kings Sterndale, near Buxton, R. S., 18/viii./13 (*J.*), G. 3154; \*♂, ♀♀, in a collection from Dove and Mill Dales, R. S., 21/iv./14 (*J.*); 1 ♂, near the R. Dove, ourselves, ix./16; Buxton & Bakewell districts, ourselves, 1918.

#### Genus CYLINDROULUS, Verhoeff.

(1894 as a subgenus, 1899 as a genus).

Prof. Silvestri informs us, *in litt.*, that he considers that *Cylindroiulus* and *Diploiulus*, Borlase, 1886 (2) are synonymous, the latter having precedence. This conclusion, however, does not meet with the approval of all continental authorities.

##### 6. *C. silvarum* (Meinert).

Syn. ? *I. punctatus*, Leach.

15-25 mm.

An animal commonly found between the bark and trunk of rotting logs. The caudal process is club-shaped.

\*♀, in a collection from Dove and Mill Dales, R. S., 21/iv./14 (*J.*); 1 ♀, near the R. Dove, ourselves, ix./16; both sexes, Bakewell district, ourselves, 1918; several, including 1 ♂, Manners Wood, near Bakewell, W. B. & S. G. B.-B., 6/vi./18.

##### 7. *C. britannicus* (Verhoeff, 1891).

Syn. *I. frianiulus*, Verhoeff, 1892.  
*I. laurus*, Meinert, as used by Bagnall and by Jackson. On this point see Bagnall's note (1) and our own (1).

16-18 mm.

An interesting tailless julid. The only known English millipede with which this is likely to be confused is *C. frisius*, Verhoeff, from which it is distinguished by the form of the gonopods of the male. Upon dissection, we found that one male taken by us at Great Longstone, 1918, belongs to this species. This specimen in spirit was 12.5 mm. long. A female taken by one of us (*S. G. B.-B.*) at Barbage Hall, 27/v./18, is probably referable to this species.

Genus SCHIZOPHYLLUM.

8. *S. sabulosum* (Linné).

20-46 mm.

This is a large and handsome julid, marked with two bright yellow dorsal stripes running the whole length of the body.

\*2 ♀♀, The Winnats, Castleton, *R. S.*, in a recent year (*J.*), G. 3164; numerous, Dove Dale, *R. S.*, *J. W. J.*, *C. R. B.*, 25/v. 16; 1 ♂ junior, near the *R. Dove*, ourselves, ix. 16; adults, Bakewell district, ourselves, 1918.

Family Protoiulidæ.

(Genus BLANIULUS (s. l.), Gervais, 1836.)

Genus TRICHOBLANIULUS, Verhoeff.

Syn. Verhoeff uses the subgeneric name *Typhloblaniulus* (13), which is used as generic by Ribaut (9).

9. *T. guttulatus* (Bosc).

Syn. ? *Iulus pulchellus*, Leach (nec *C. L. Koch*).

9-18 mm.

A common blind blaniulid, which is sometimes a pest in potato crops. It is a worm-like form.

Both sexes, Bakewell district, ourselves, 1918.

Genus AMSTEINIA, Verhoeff.

10. *A. fuscus* (Am Stein).

9-16 mm.

Males of this species are rare; the present record is, however, admissible, as the eyes prove a useful diagnostic character. The ocelli are arranged much the greater number in a long single row, the remainder in a small elongated triangle with its base against the central part of the row. The animal



is often associated with *Cylindroiulus silvorum*, and its usual habitat is between the bark and trunk of rotting logs.

Very few specimens (no adult ♂), Bakewell district, ourselves, 1918.

Family **Polydesmidae**, Leach (ex p.), 1814.

Genus **POLYDESMUS**, Latreille, 1802 & 1804.

11. *P. complanatus* (Linné).

13-28.5 mm.

This large flat-backed millipede is common in the British Isles. Its gonopods are distinctive. The genus has twenty body-segments.

\*2 ♂♂, The Winnats, Castleton, *R. S.*, in a recent year (*J.*), G. 3149; \*2 ♂♂ and juniors, Cave Dale, *R. S.*, in a recent year (*J.*), G. 3136; \*♂♂ & ♀, in a collection from Dove and Mill Dales, *R. S.*, 21 iv. 14 (*J.*); ♂, near the R. Dove, ourselves, ix. 16; Bakewell, ourselves, 4 vi. 18; 1 ♂, Manners Wood, near Bakewell, *W. R. & S. G. R. B.*, 6 vi. 18; Bakewell district, ourselves, 1918.

12. *P. coriaceus*, Porat.

12.5 mm.

This species is smaller than *P. complanatus*, also the males have distinctive gonopods. A male from Great Longstone which we dissected for careful diagnosis was 12.5 mm. long.

Bakewell district, ourselves, 1918.

13. *P. denticulatus*, C. L. Koch, 1847.

10-16 mm.

Again the gonopods of the male are diagnostic. In this character we did not find the male recorded below quite typical. The slight difference, however, is probably no more than an individual peculiarity in the specimen in question. On the whole the condition of the gonopod is similar to that of the preparation given by Dr. Bülemann in figure 34 in the xviii. paper of the 'Biospeologica' series (7). In our example the secondary ramus is arched much as that is in the fig. 34 cited. To adopt the lettering used by Dr. Bülemann, its external appendix (*p*) is well developed, broad, slightly arched, and furnished with a well-marked sharp tooth (*p'*) near the base, as in figure 34 (*op. cit.*). The individual difference we have noted (*ante*) consists in the presence of a second small tooth on the internal face of the distal part of

the secondary ramus. The seminal ramus presents the usual features; the small tooth (*y*) of the external face is well-developed.

1 ♂ (and ? other material), near the R. Dove, ourselves, ix./16.

Genus *BRACHYDESMUS*, C. Heller, 1857.

Species *B. superus*, Latzel, 1884.

14. *B. superus mosellanus*, Verhoeff, 1891.

8.5-9 mm.

The genus to which this animal belongs has nineteen body-segments. The present variety, with typical gonopods in the male, seems to be the common English form. We have dissected specimens from both the localities mentioned below. In the garden of Beech House, Great Longstone, we met with large numbers of the animal.

Baxton and Bakewell districts, ourselves, 1918.

Genus *OPHIODESMUS*.

15. *O. albomanus* (Latzel).

Syn. *Paradesmus albomanus*, Latzel.

4.5 mm.

This minute square-backed millipede (our spirit-specimen is 4.5 mm. long) will probably prove to be not uncommon in Britain. Dr. Brölemann kindly confirmed the species by examining a drawing of the gonopod dissected from a specimen collected in another part of the country by our friend Mr. Bagnall, who was good enough to send it to us, correctly labelled. The example recorded below was adult, being furnished with the characteristic\* gonopods of the species. We suspect that the animal occurs in the garden of Ashford Vicarage, but we failed to obtain adult males there in spite of careful collecting.

1 ♂, in the garden of Mrs. Thornhill's home, Beech House, Great Longstone, ourselves, 1918.

Family *Brachychæteumidae*, Verhoeff et Brade-Birks, 1911, 1918.

Genus *BRACHYCHÆTEUMA*, Verhoeff et Brade-Birks, 1911, 1918.

Syn. Owing to errors in Verhoeff's original description we established *Jacksonuma*, 1917, to receive a new species *Brachychæteuma bradei* (Brölemann et Brade-Birks, 1917) (c). In the light of new material of the genotypical species, *Jacksonuma* becomes a synonym of *Brachychæteuma*.

16. *B. quantum*, Brade-Birks (to be described later in the present paper).

♀ 7-8 mm.

While collecting on a slope by the side of the Ashford road, close to the town of Bakewell, one of us (*H. K. B.-B.*) came across a specimen of a square-backed millipede which we recognized in the field as belonging to the family Brachychætenidae. Although we searched carefully not only both of us on this, but also one of us on another occasion, we failed to collect another example. It became clear upon examination with the microscope that this specimen could not be referred to any of the three known species; a description is therefore given in another part of this paper.

1 ♀, near Bakewell, *H. K. B.-B.*, 29/v. 18.

Family **CRASPEDOSOMIDÆ**, Verhoeff, 1909.

Subfamily **CRASPEDOSOMINÆ**, Verhoeff, 1909.

Tribe **CRASPEDOSOMINI**, Verhoeff, 1909.

Genus **POLYMICRODON**, Verhoeff, 1897.

Subgenus **POLYMICRODON** (*s. str.*), Verhoeff, 1897.

17. *P. latzeli* (Verhoeff, 1891).

Syn. *Atractosoma latzeli*, Verhoeff, 1891.

♀ *Atractosoma polydesmoides*, Leach.

♀ *Atractosoma latzeli gallicum*, Verhoeff, 1895.

♀ *Craspedosoma latzeli gallicum*, Verhoeff, 1896.

♀ *Poly microdon latzeli gallicum*, Verhoeff, 1897.

17-18 mm.

A flat-backed animal with thirty body-segments. We have little doubt that this species should be called *P. polydesmoides* (Leach), but until the type-specimens of Leach's animal are examined it seems unwise for us to make the alteration. The characteristic gonopods are figured by Verhoeff (12), and those of *P. latzeli gallicum*, which is perhaps a synonym, by Ribaut (11).

\* ♂, *Cave Dale*, *R. S.*, in a recent year (*J.*), G. 3147. We also took specimens almost certainly referable to this species in the Bakewell district, 1918, but there were no adult males for definite diagnosis.

Family **Chordeumidæ**, Verhoeff, 1899.

Subfamily **MICROCHORDEUMINÆ**, Verhoeff, 1910.

Genus **CHORDEUMELLA**, Verhoeff.

Species *C. scutellare*, Ribaut, 1913.

18. *C. scutellare hagnalli*, Brade-Birks (to be described later in the present paper).

6.0 mm.

While collecting in the garden of Beech House, Great Longstone, one of us found a number of specimens of a small millipede of the genus *Chordeumella*. Upon microscopic examination it became evident that this creature cannot be referred to the only known British representative of the genus, *C. scutellare brölemanni*, Brade-Birks, although it falls into the species *C. scutellare*. Nevertheless we found differences which justify a subspecific name for this animal, which is described later in this study.

Numerous males, but no satisfactory females, *S. G. B.-B.*, Great Longstone, 1918.

Class **CHILOPODA**.

Family **Lithobiidæ**, Newport, 1841.

Genus **LITHOBUS**, Leach, 1814.

19. *L. forficatus* (Linné, 1758).

15-22 mm.

This large and active brown centipede has more than two feet on each of the coxæ of the maxillipedes. Its seventh dorsal plate is not produced posteriorly. The anal legs are stout. It is common all over the British Isles, under stones and in other damp situations. We have previously (4) recorded it for the county, as it was sent to us from Great Longstone (1 ♀, *A. W. F.*, 13/x./15); \*Dove Dale, *R. S.*, iv./12 (*J.*), *G.* 3172; \*in a collection from Dove and Mud Dales, *R. S.*, 21.iv./14 (*J.*); near the R. Dove, ourselves, ix./16; Manners Wood, near Bakewell, *W. B. & S. G. B.-B.*, 6.vi./18; Burbage Hall, *S. G. B.-B.*, 27/v./18; Buxton and Bakewell districts, ourselves, 1918.

20. *L. variegatus*, Leach et Brölemann.

20 mm.

This large and truly British variegated centipede has more

than two teeth on each of the coxae of the maxillipedes. Its seventh dorsal plate has angular projections from each end of its posterior border. The anal legs are slender. It is often to be found under stones in moorland districts. We do not seem to have met with it ourselves in the Carboniferous Limestone areas of Derbyshire in 1918.

\* ♂ ♀, Kings Sterndale, near Buxton, *R. S.*, in a recent year (*J.*), *G.* 3176; \* in a collection from Dove and Mill Dales, *R. S.*, 21/iv. 14 (*J.*); near the R. Dove, ourselves, ix./16; Manners Wood, near Bakewell, *W. B. & S. G. B.-B.*, 6/vi. 18.

21. *L. melanops*, Newport, 1845.

Syn. *L. glabratus*, C. L. Koch, 1847.

10-16 mm.

A species, with numerous ocelli and 2+2 maxillipede-teeth, which has definite angular projections from the posterior borders of its ninth, eleventh, and thirteenth dorsal plates. It is not uncommon between the trunk and bark of rotting logs.

Burbage Hall, *S. G. B.-B.*, 27/v. 18.

22. *L. crassipes*, L. Koch, 1862.

6-9 mm.

A small active brown centipede, with only twenty antennal segments.

\* Dove Dale, *R. S.*, in a recent year (*J.*), *G.* 3165; near the R. Dove, ourselves, ix. 16; Manners Wood, near Bakewell, *W. B. & S. G. B.-B.*, 6 vi. 18; Bakewell district, ourselves, 1918.

23. *L. dubosequi*, Biölemann.

5.5-7 mm.

Another small species, not unlike *L. crassipes*, but provided with only three ocelli on each side of the head in typical cases.

The Vicarage garden, Ashford-in-the-Water, ourselves, 1918.

Family Scolopendridæ, Newport, 1844.

Genus CRYPTOPS, Leach, 1814.

24. *C. hortensis*, Leach, 1814.

Syn. *C. variegata*, Leach, 1817.

15-25 mm.

A form intermediate in organization between *Lithobius* and *Geophilus*.

A few, Bakewell district, ourselves, 1918.

Family **Geophilidæ**, Leach, 1814.

Genus **GEOPHILUS**, Leach, 1814.

25. *G. carpophagus*, Leach.

Syn. *G. sodalis*, Bergsæe et Meinert.

*G. condylogaster*, Latzel, 1880.

41 mm.

This is a dark brown species of our well-distributed genus *Geophilus*. The pegs of the anterior ventral plates are prominent and the corresponding sockets comparatively small. We have not ourselves met with this species in the county.

\* Above Dale, R. S., 21 iv./14 (J.).

26. *G. longicornis*, Leach, 1814.

Syn. *G. fluvus* (De Geer, 1778).

10 mm.

A detailed examination of examples of this species will show that the true peg-and-socket or "carpophagous" structure is wanting in the ventral plates of the animal's body. This character is present in all its known English congeners.

\* 2 ♀♀, Castleton, R. S., ix./13 (J.), G. 3135; near the R. Dove, ourselves, ix./16; 1 ♀ with forty-seven pairs of legs, Manners Wood, near Bakewell, W. R. & S. G. B.-B., 6 vi./18; Bakewell district, ourselves, 1918.

27. *G. insculptus*, Attems, 1895.

Syn. The name "*G. proximus*" has been used by other authors in this country and ourselves to record animals which undoubtedly belong to *G. insculptus*. The true *G. proximus*, C. L. Koch, 1847, is unknown to us.

25 mm.

In May and June we found *G. insculptus* to be a fairly common species, and we obtained a good number of specimens. The socket of the anterior ventral plates is large.

Buxton and Bakewell districts, ourselves, 1918; Barbagoe Hall, S. G. B.-B., 27 v./18.

28. *G. electricus* (Linné, 1758).

45 mm.

This is an interesting species, not very common in the

north of England, but apparently well distributed. The specimen recorded below has sixty-nine pairs of legs, and is furnished with typical pores on the coxæ of the anal legs.

1, junior, Bakewell district, ourselves, 1918.

Genus BRACHYGEOPHILUS, Brülemann, 1909.

29. *B. truncorum* (Bergsøe et Meinert).

10-14 mm.

This is the type of the genus, which resembles *Geophilus*. In *Brachygeophilus* the sternites are without pore-fields, the coxal pores are much reduced, the species are very small, and the number of their somites is low and only slightly variable (6). In the case of *B. truncorum* there are three marked depressions on the surface of the anterior ventral plates. It is common in the north of England.

Near the R. Dove, ourselves, ix./16; Bakewell district, ourselves, 1918.

Genus STIGMATOGLASTER, Latzel, 1880.

30. *S. subterraneus* (Leach).

Syn. *Himantarium subterraneum* (Leach).

20 mm.

A large species with a clearly defined central pore-field on the anterior ventral plates.

Bakewell district, ourselves, 1918.

Genus SCOLIOPLANES, Bergsøe et Meinert, 1866.

31. *S. acuminatus* (Leach, 1814).

20-34 mm.

This is one of the darker geophilids. The maxillipedes of this genus are sufficiently characteristic to distinguish it at a glance from *Geophilus*. In this species, according to Latzel (8), the male always (in Austria) has thirty-nine pairs of walking-legs; there were thirty-nine pairs in the example recorded below. It would appear that the female may have from forty-one to forty-seven pairs, though Latzel only knew them (*loc. cit.*) with forty-one to forty-three pairs.

1 ♂, near the R. Dove, ourselves, ix./16.

### III. DESCRIPTIONS OF THE TWO NEW MILLIPEDES RECORDED ABOVE, WITH NOTES.

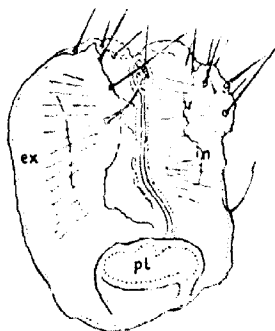
#### *Brachychæteuma quartum*, sp. n.

Dimensions approximately the same as those of the known species. Ocelli present, well but irregularly pigmented, few in number—three. The other external characters and the mouth-parts agreeing with the type of the genus. Male unknown.

*Female*.—The female presents the usual sexual differences.

*The vulva*.—In the "cyphopodite" the chitinization, both of the pilose lateral lobes (fig. 1, *ex*, *in*) and of the naked posterior lobe (*pl*), is well marked. The posterior lobe is

Fig. 1.



*Brachychæteuma quartum*, posterior view of the right vulva. *ex*, *in*, external and internal lobes of the "cyphopodite"; *pl*, posterior lobe.  $\times 200$ . H. K. B.-B. del.

simple in form, and is neither provided with a marked median elevation nor with lateral folds of chitin, though, as usual, the chitin of the posterior lobe as a whole is stouter than that of the rest of the organ. When viewed from behind the distal limit of the posterior lobe is almost flat and its lateral borders are simple, being convex in profile. From the same point of view a strong band of chitin is seen to arise from the external edge of the lobe at the height of its convexity; this band passes transversely towards the internal edge, and, losing its definition, hardly unites with it. A



short, proximally directed ridge of the same nature arises from a similar position on the internal border of the lobe.

*Hab.* Bakewell, wild, in a well-wooded Carboniferous Limestone district, under a stone.

*Type.* Slides 1275 and 1276, tube 1277, Brade-Birks collection.

It seems a convenient opportunity to give a diagnostic key to the females of the genus *Brachychateuma*, as follows:—

- |   |    |   |
|---|----|---|
| 1 a. Posterior lobe (of the "cyphopodite") lacking a pair of definite circular thickenings of chitin .....          | 2. |   |
| 1 b. Posterior lobe furnished with a pair of definite circular thickenings of chitin ..                             |    | Birks.  |
| 2 a. Posterior lobe with a marked median elevation .....  |    | <i>B. melanops</i> , Brade.                       |
| 2 b. Posterior lobe without a marked median elevation .....   | 3. |   |
| 3 a. Posterior lobe with a small median elevation and well-marked lateral folds of chitin .....                     |    | <i>B. quantum</i> , nobis.                        |
| 3 b. Posterior lobe with a large and outwardly directed median elevation, but lacking lateral folds of chitin ..... |    | Brade-Birks.<br><i>B. bagualli</i> , Vercoffet.   |
|   |    | Fet Brade-Birks.<br><i>B. bradea</i> , Bradenham. |

In the males of the genus it seems probable that development of the telepodite of the anterior gonopods runs parallel with the development of the posterior lobe of the "cyphopodite" in the vulva of the female. If that is really so, we should expect that when examples of the male of *B. quantum* are found, the telepoditic elements of the anterior gonopods will be similar to those of *B. bradea* and *B. bagualli*—perhaps slightly less complicated; we should not expect the complex condition of the telepoditic horns found in *B. melanops*. In the species known previously the coxal prolongations of the anterior gonopods have been useful diagnostic features, and by analogy we should expect them to differ in *B. quantum* from those of the other species and to be simpler in form than in any of them. Thus, they should most closely resemble the coxal prolongations of *B. bagualli*\*. The syncoxite of the same gonopods appears to be a fairly constant feature, and so it is to be expected that in this character and in the disposition of the pseudoflagella the male of *B. quantum* will agree with the other species.

\* The coxal prolongations might, for example, be broader distally and less elevated than in *B. bagualli*.

*Chordeumella scutellare bagnalli*, var. n.

*Dimensions of the male*.—Length 6·0, breadth 0·6 mm.

*Other external characters*.—In all essentials these are the same as those of *C. scutellare hölemani*, though, perhaps, the new variety is rather darker dorsally.

*Modified Appendages of the Male*:

*Anterior paragonopods* (fig. 2).—These show characters intermediate between those of the type of the species and the variety *C. scutellare hölemani*. The appendages are represented by a pair of conical processes, the coxal elements,

Fig. 3.

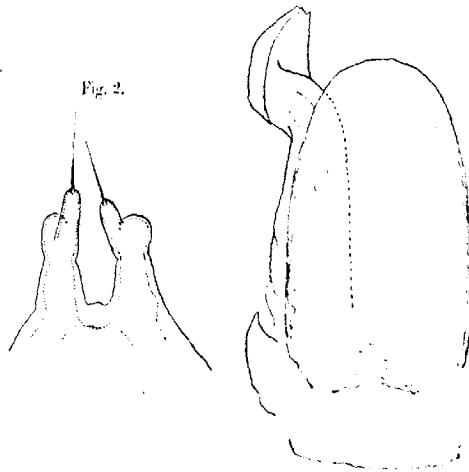
*Chordeumella scutellare bagnalli*.

Fig. 2.—Anterior paragonopods,  $\times 200$ . H. K. B.-B. del.

Fig. 3.—Sternite and left femorite of the anterior gonopods,  $\times 200$ . H. K. B.-B. del.

which bear long apical hairs. A definite indentation of the internal border of each paragonopod, due to an obtuse-angled inward bend of the appendage, corresponds in position to a feeble fold in the case of *C. scutellare scutellare*. The shoulder opposite the indentation is developed into a rounded pigmented naked projection on the external border of the limb. This projection is the rudiment of a telepodite, but the point of division between telepoditic and coxal elements is

nearer obliteration than is the case in *C. scutellare brölemanni*. Whereas in *brölemanni* the apices of the telepoditic and coxal elements are of about the same elevation, in this new variety the telepoditic element falls considerably short of the elevation of the coxite.

*Anterior gonopods* (fig. 3).—These, again, are intermediate in form between those of the type of the species and *brölemanni*. The sternite is furnished with a median prolongation, well developed and tongue-like in shape and simply rounded at its extremity, its distal border being neither emarginate as in *C. scutellare scutellare*, nor drawn out into a definite peak-like projection as in *C. scutellare brölemanni*.

*Posterior gonopods, first pair of legs of the eighth segment, posterior paragonopods*.—In all essentials these agree with the corresponding limbs of the type of the species; thus they also resemble those of *brölemanni*.

*Female*. Adult unknown.

*Hab.* Under wood, on a garden-path, etc., Beech House, Great Longstone, 1918.

*Dedication*. We have pleasure in naming this variety in honour of our friend and colleague Mr. R. S. Bagnall, F.L.S. etc., of Blayden-upon-Tyne.

*Types*. Type 1271, slides 1272, 1273, 1274, and 1319. Brade-Birks collection.

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XXXII.—Notes on various Species of the American Genus *Astylus*, Cast., with Descriptions of their Sexual Characters [Coleoptera]. By GEORGE CHARLES CHAMPION, F.Z.S.

(CERTAIN species of the Malacoderm genus *Astylus*, Cast. (= *Macroglossa*, Solier) exhibit remarkable sexual characters, two only of which appear to have been specially noticed by authors, viz., the broad, vertical lamella on each side of the terminal abdominal segment in ♂♂ of *A. trifasciatus* and *A. gayi*, mentioned by Guérin, and the deeply emarginate, bispinose apices of the elytra in ♀♀ of *A. octopustulatus* and *A. antillarum*, observed by Gorham. The presence of these and other important external structures, accompanied by peculiarities in the ♂ genital armature (visible in many dried specimens), has induced me to examine the tegmen and aedeagus (penis-sheath\*) of nearly all the species represented in the British Museum, or in that of the Hope Collection at Oxford. These chitinous structures are noticed in detail in the present paper; and in a number of cases the insect itself, owing to uncertainties of identification, is re-described, or named, if new. The principal external characters observed, apart from the longer antennae or curved tibiae of the males of certain species, are:—(1) the presence of two compressed, subconical, tuberculiform or dentiform prominences on the metasternum in ♂ (*A. octopustulatus*, *gorhami*, &c.); (2) the long, spiniform, anterior trochanters in ♂ (*A. subgriseus*); (3) the obliquely produced or dentiform inner apical angles of one or more of the intermediate joints of the anterior tarsi in ♂ (*A.antis*, *splendidus*, *correptus*, and *convexus*); (4) the posteriorly constricted elytra in ♂ (*A. correptus*); (5) the deeply emarginate, bispinose apices of the elytra in ♀ (*A. octopustulatus*, *gorhami*, *antillarum*, &c.); (6) the sinuat-truncated apices of the elytra, with sharp or dentiform sutural angle, in ♀ (*A. quadrilineatus*, *imbricatus*, &c.); (7) the elongate, conical, terminal, abdominal segment in ♂ (*A. sexmaculatus*, &c.); (8) the laterally lamellate terminal abdominal segment, and broadly divided fifth ventral segment, in ♂ (*A. trifasciatus* and *gayi*); (9) the forcipate terminal dorsal segment in ♂ (*A. forcipatus*).

The tegmen of the ♂ in many of the species is very deeply emarginate or cleft at the apex (*A. trifasciatus*, &c.); in others it is feebly emarginate (*A. octopustulatus*, &c.), truncated (*A. cyanerythrus*, &c.), or simply rounded at the

\* Median lobe of Sharp and Muir.

tip (*A. correptus*); the margins of the distal portion of this organ are usually clothed with long curled hairs. The very elongate penis-sheath exhibits a variety of forms: (1) almost straight from near the base and simply pointed at the tip (*A. antis* and many other species); (2) broad, compressed, and obliquely truncate at the tip (*A. sexmaculatus*); (3) constricted distally, and obliquely truncate and sub-securiform at the tip (*A. vittaticollis*); (4) flattened and strongly bisinuate as seen in profile (*A. trifasciatus* and *gayi*). The long membranous sac, containing the true intromittent organ, has not been examined: the distal portion of it is usually seen protruding from the dorsal surface of the penis-sheath at some distance before the apex of the latter, and in some cases the exposed part appears to be studded with asperities or short bristles\*. The terminal abdominal segment of the ♂ is separated from the preceding segment, on both the ventral and dorsal aspects, by a membranous space, extending broadly forward along the entire length of the fifth ventral segment in *A. trifasciatus*, *sexmaculatus*, &c., allowing great freedom of movement of this portion of the body during copulation. In several species a thickened hook-like process has been noticed on the front of the first ventral segment in ♂; but as this structure is almost covered by the posterior coxæ, and cannot be seen till the abdomen is detached, no use has been made of it in the present paper.

The genus *Astylus* extends over the greater part of South America, and is particularly well represented at high elevations in the Ecuadorian Andes, two species occurring as far north as Panama, and two in the Lesser Antilles. The large Chilean forms have been placed under a separate genus, *Mecoglossa*, by Solier, a name that might conveniently be retained for them, on account of the extraordinary genital armature of the ♂, and the cleft terminal ventral segment of the ♀. Since the publication of the "Munich" Catalogue of Malacodermata, in 1869, numerous species of *Astylus* have been described or named by Kirsch, Berg, Steinheil, Gorham, Bourgeois, and Pic. It is questionable whether one of the papers by the last-named author, entitled "Sur le genre *Astylus*, Cast." (*L'Echange*, xvii. pp. 34-36, 1902), containing many proposed new names for S. American forms, unaccompanied by definite descriptions or measurements, and issued solely—as the author states—to secure priority, should

\* The genitalia examined have been dissected by Mr. A. Cant. To extract these pieces without injury, it has been found necessary to boil the detached abdomen in caustic potash.

be recognized \*. These hairy insects are found gregariously on flowers in open places, and they bear a certain relationship to the Palearctic *Henicopus*, wanting the peculiar structures in the legs of the males so conspicuous in nearly all the members of the last-named genus. The two species found in abundance by myself in Chiriqui in 1881-83 are still the only known representatives of *Astylus* recorded from north of the Isthmus of Panama.

The forms represented in the British Museum collection may be grouped by their structural characters or ♂ armature thus:†—

- a. Metasternum without tubercles or dentiform processes in ♂.
- a'. Wings fully developed.
- a<sup>2</sup>. Terminal abdominal segment with broad vertical lamellæ in ♂, the segment itself transverse on the ventral aspect; sixth ventral segment divided in ♀; elytra more or less costate and rugosely punctured: ♂ with bilobed tegmen and strongly sinuate penis-sheath: species large, Chilean *Mecoclossa*, Sol. .... Nos. 1, 2.
- β. Terminal abdominal segment without lamellæ, conical or narrowed posteriorly in ♂; sixth ventral segment divided in ♀; elytra not costate: ♂ of *A. sermaculatus* with bilobed tegmen and broad, obliquely truncate penis-sheath .... Nos. 3, 4.
- γ. Terminal abdominal segment as in β: sixth ventral segment not divided in ♀.
- α. Elytra not constricted posteriorly in either sex, at most obsolete costate.
- α'. Elytral apices rounded or obtuse in ♂ ♀, or (*A. vittatus*) obliquely truncate in ♀.
- α'. ♂ with bilobed or emarginate tegmen and acuminate penis-sheath, the intermediate joints of anterior tarsi angulate at inner apical angle in *A. antus* and *splendidus*.
- α<sup>2</sup>. Anterior trochanters simple in ♂ .... Nos. 5-22.
- β'. Anterior trochanters long and apiniform in ♂ .... No. 23.
- β'. ♂ with bluntly rounded or truncated tegmen and acuminate penis-sheath .... Nos. 24, 25.
- γ'. ♂ with bilobed tegmen and apically dilated penis-sheath .... No. 26.

\* This article is catalogued in the 'Zoological Record' for 1902, p. 140, as "Notes on proposed n. spp.," but the paper itself is not analysed, and the new names are not given.

† Males of *A. hematostictus*, *serpentinatus*, *conversus*, and *amabilis* not dissected, those of *A. pallipes*, *imbricatus*, and *laticauda*, and female of *A. forcipatus* wanting.

- b<sup>4</sup>. Elytral apices sinuato-truncate and sutural angles sharp in ♂ ♀\*: ♂ with emarginate tegmen and acuminate penis-sheath . . . . No. 27.
- a<sup>5</sup>. Elytra constricted posteriorly in ♂, subparallel in ♀, sharply costate laterally in both sexes: ♂ with joints 2 and 3 of anterior tarsi produced at inner apical angle, the tegmen rounded at tip, and the penis-sheath acuminate . . . . . No. 28.
- d<sup>6</sup>. Terminal abdominal segment with a long process on each side in ♂, the tegmen truncate, and the penis-sheath acuminate; elytra bicostate, the inner costa prominent. . . . . No. 29.
- b<sup>7</sup>. Wings wanting or rudimentary; elytra not costate; ♂ with joints 2 and 3 of anterior tarsi produced at inner apical angle. . . . . No. 30.
- b. Metasternum bituberculate or bidentate in ♂; elytra uni- or bicostate; wings fully developed: ♂ with tegmen truncate or feebly emarginate and penis-sheath acuminate.
- c. Elytral apices rounded or truncate in ♂, bispinose and deeply emarginate in ♀ . . . . . Nos. 31-36.
- d. Elytral apices rounded or subtruncate in ♂, sinuato-truncate, and with the sutural angles sharp and overlapping, in ♀ . . . . . Nos. 37-39.

#### 1. *Astylus trifasciatus*.

*Dasyles* (*Astylus*) *trifasciatus*, Guér. Icon. Règne Anim. p. 48, t. 15, figs. 2 & c; Redt. Reise Novara, ii. p. 109.

*Microglossa rugosa*, Solier, in Gay's Hist. Chile, iv. p. 426, t. 10, figs. 5 & 9.

♂. Ventral sutures 1-4 oblique from the outer margin to median line; segment 4 with a stout hook in the middle at the base; segment 5 long, divided into two, widely separated, apically convergent lobes, which are broadly sustentate at the tip, the median portion membranous. Terminal segment elongate on the dorsal aspect, transverse on the ventral aspect, angulate on each side towards the apex beneath, the apical portion dilated laterally into a broad, vertical, inwardly concave, securiform lobe, and the apical margin toothed in the centre above. Tegmen with moderately long, dilate, feebly curved, lateral lobes, which are subtruncate or bluntly rounded at the tip. Penis-sheath very strongly, bisannately curved, tapering at the tip.

♀. Ventral segment 6 about as long as 5, cleft, and separated laterally from the dorsal portion.

#### *Hab. CHILE.*

Apparently a common species in some parts of Chile.

\* Possibly a variable character in this species, *A. quadrinotatus*.

This insect has extremely rugosely punctured elytra, and two more or less distinct costæ on the disc; the first and second fasciæ are usually connected with the dark sutural stripe, and the latter is sometimes dilated at the tip. The females are broader than the males, and some of them (labelled with the MS. name *Mecoglossa intermedia* in the Fry collection), from Lota, Chillan, &c., have much less coarsely punctate elytra. The long hairs on the under surface are cinereous in colour in the rugose form, and intermixed with black hairs in the smoother examples. The elytral markings are sometimes reduced to two spots on the outer part of the disc, the anterior one being quite small. Females largely preponderate in the long series before me, few of which are labelled with any definite locality.

## 2. *Astylos gayi*.

*Dasytes (Astylos) gayi*, Guér. Icon. Règne Anim. p. 48.

*Mecoglossa affinis*, Solier, in Gay's Hist. Chil., iv. p. 427.

*Dasytes porrectus*, Buquet, in Dej. Cat. 3rd edit. p. 123 (1837).

*Hab.* CHILE, Valparaiso (*C. Darwin*), Concepcion, San Blas, Coquimbo (*Mus. Brit.*), Atacama (*R. M. Midgilton*), &c.

This insect is a smoother, very hairy form of *A. trifasciatus*, with the elytral markings usually reduced to three angular patches along the outer part of the disc and the sutural stripe dilated at the base and apex, and the long hairs on the under surface entirely or in great part black. The two forms have precisely similar ♂ armature, and the smoother females alluded to under *A. trifasciatus* would be equally well placed under either of them.

## 3. *Astylos sermaculatus*.

*Dasytes sermaculatus*, Porty, Del. Anim. art. Bras. p. 29, t. 6. fig. 15.

Blanch. in Voyage d'Orbigny, vi. 2. p. 206.

*Dasytes pictus*, Dej. Cat. 3rd edit. p. 123 (1837).

♂. Ventral segment 1 with a blunt hook in the centre at the base; 5 broadly cleft down the middle, the lateral portions subtruncate at the tip. Terminal segment long, tubulate, narrowing outwards, emarginate laterally at the apex. Tegmen with long, spoon-shaped, slightly sinuous lateral lobes, which are curved inwards at the tip, and thickly fringed with long hairs. Penis-sheath stout, compressed, the outer portion broadly, obliquely truncate, as seen in profile.



♀. Ventral segment 5 short, triangular, emarginate, 6 cleft, shorter than 5.

*Hab.* BRAZIL, Rio de Janeiro (*Blanchard, Fry*), São Paulo (*Perty*), Alto de Serra Paulo (*G. E. Bryant*).

A long series seen, males preponderating, showing scarcely any variation, except in size. The penis-sheath of the ♂, examined in many specimens, is very different from that of any of the allied species dissected.

#### 4. *Astylus hæmatostictus*, sp. n.

Elongate, narrow, shining, nigro-pilose above and beneath; nigro-cæruleous, the head and prothorax greenish, the elytra with an oblong spot at the base, the lateral margins to near the middle, a triangular postmedian patch on the disc, and a transverse subapical mark, luteous or reddish, the antennæ testaceous to about the middle; the head and prothorax finely, the elytra rather coarsely punctate. Head not much developed behind the eyes; antennæ moderately long in ♂, short in ♀. Prothorax transverse, rounded at the sides in both sexes. Elytra long, subparallel in their basal half.

♂. Ventral segment 5 broadly arcuato-emarginate, 6 moderately long, conical, cleft down the middle.

♀. Ventral segment 6 short, divided down the middle.

Length 6-6½, breadth 2½-2¾ mm. (♂ ♀.)

*Hab.* BRAZIL, Minas Geraes (*Mus. Brit.*).

Described from a pair acquired by the Museum in 1844, the ♂ labelled with the MS. specific name *hæmatostictus*. An elongate, narrow, metallic insect, with nigro-cæruleous elytra, which are each marked with three rather large luteous or reddish spots—one basal (oblong), one postmedian (triangular), and one subapical (transverse). A larger abraded ♀ (length 8¼ mm.), from Puacatambo, Peru, too imperfect to name, differs from the Brazilian insect in having the elytra less coarsely punctate, and the three spots transverse, the second forming a definite arcuate fascia. *A. hæmatostictus* seems to be nearest allied to *A. sexmaculatus*, Perty, from which it is separable by its smaller size, narrower form, and the differently shaped spots on the elytra. The unique male has not been dissected.

#### 5. *Astylus antia*.

*Dasytes antia*, Perty, Del. Anim. art. Bras. p. 29, t. 6, fig. 13 (1833); Cast. Hist. Nat. Coleopt. i. p. 280.

*Dasytes flavofasciatus*, Blanch. in Voyage d'Orbigny, vi. 2, p. 97, t. 6, fig. 10.

*Astylus fasciatus* [Germ. in Dej. Cat. 3rd edit. p. 123, Sharp and Muir, Trans. Ent. Soc. Lond. 1912, pp. 540, 541 (♂ genit. armature)].

♂. Anterior tarsi with joints 3 and 4 angulate, and 2 obliquely dentate, at the inner apical angle. Ventral segment 5 broadly, deeply emarginate. Terminal segment long, tubulate, narrowing from the base, cleft beneath. Tegmen narrowly cleft for a short distance at the apex, which is fringed with long hairs. Penis-sheath narrowed and somewhat acuminate at the tip.

♀. Ventral segment 6 short, undivided, feebly notched at the apex.

*Hab.* BRAZIL, Rio de Janeiro, Santa Catharina, São Paulo, Rio Grande, &c.; PARAGUAY, Sapucay (*W. Foster*); ARGENTINA, Corrientes (*sec. Blanchard*).

Of the twenty-five specimens before me, females preponderating, five belong to the smaller form with a relatively narrow prothorax in both sexes, this latter corresponding to the *D. flavofasciatus* of Blanchard, from Corrientes, Rio Grande, Sapucay, &c. A male of each has been dissected, and the armature proves to be precisely similar. The broad, complete, submedian flavous fascia on the elytra separates *A. antis* from *A. splendidus*. The prothorax and the base of the elytra are thickly set with long, erect or projecting, black hairs in both of them. The length varies from 10-16 mm.

#### 6. *Astylus splendidus*.

*Dasytes splendidus*, Cast. Ann. Soc. Ent. Fr. 1832, p. 398; Hist. Nat. Coleopt. i. p. 280.

*Hab.* BRAZIL (*Mus. Oxon.*), Rio de Janeiro (*Fry*).

This is a large very brilliantly coloured form of *A. antis* with the flavous markings on the elytra reduced to an oblique subapical fascia on the outer part of the disc; the fascia, however in one of the five examples seen (2 ♂♂, 3 ♀♀) reaches the suture and is continued along it for a short distance forward. The ♂ characters are similar to those of *A. antis*, and the two insects are certainly nothing more than forms of one species. Both occur at Rio de Janeiro, where also the smaller and narrower *A. flavofasciatus*, Blanch., has been found.

#### 7. *Astylus aulicus*.

*Astylus aulicus*, Dej. Cat. 3rd edit. p. 129 (1837); Pic. Bull. Soc. Ent. Fr. 1908, pp. 328, 329.

♂. Ventral segment 5 broadly, semicircularly emarginate about as long as 5, undivided, with a narrow, deep, triangular

notch at the apex. Tegmen with two long, widely separated, straight lateral lobes, which are fringed with long hairs at the tip. Penis-sheath stout, acuminate and slightly upturned at the apex.

♀. Ventral segment shorter than 5, simple.

*Hab.* COLOMBIA; VENEZUELA.

A common insect in the countries quoted. The typical form has a transverse, angulate red patch on the outer part of the elytra before the middle, sometimes (var. *fenestratus*, Pic, l. c.) extending forward along the outer margin and up the middle of the disc to the base. Examples also occur with a small red spot at the base and one or two others beyond the middle. The ♂-characters are described from three specimens dissected many years ago by Dr. Sharp.

#### 8. *Astylus rubripennis*.

*Dasytes rubripennis*, Latr. in Voyage Humboldt, i. p. 178, t. 17, fig. 3.  
*Melyris (Astylus) rubripennis*, Er. in Wieg. Archiv für Naturg. xiii. 1, p. 84.

♂. Ventral segment 5 broadly arcuato-emarginate, 6 with an oblong excavation in the centre at the apex, and the apex itself deeply emarginate. Tegmen with short, broad lateral lobes, the apices of which are obliquely truncate and thickly set with long hairs. Penis-sheath stout, gradually narrowed and slightly curved at the tip.

*Hab.* ? COLOMBIA (*Mus. Brit.*); PERU, Jacq. de Bracmorias (*Humboldt and Bonpland*).

Two males in the Museum labelled "Colombia" and acquired in 1844, agree with Latreille's figure of *D. rubripennis* and Eichson's subsequent description of the same species. The elytra have the reddish portion of the surface more extended than in *A. bonplandi*, leaving a broad, posteriorly angulate space at the base (enclosing an oval or oblong reddish patch), a small spot on the disc towards the apex, and the sutural and apical margins black. The very different ♂-armature shows that the two insects are distinct.

#### 9. *Astylus bonplandi*.

*Melyris (Astylus) bonplandi*, Er. in Wieg. Archiv für Naturg. xiii. 1, p. 84 (1847).

*Dasytes rubripennis*, var., Latr. in Voy. Humboldt, i. p. 178, t. 17, fig. 4.

*Astylus bonplandi*, Bourg. Bull. Mus. Paris, 1911, p. 212.

♂. Ventral segment 5 broadly arcuato-emarginate, 6 un-

divided, with a small, deep, triangular notch at the tip. Tegmen with rather broad, long, lateral lobes, which are angularly dilated at the apex within, the apices clothed with black hairs. Penis-sheath almost straight from near the base, abruptly narrowed at the tip, the narrow apical portion slightly thickened distally.

♀. Ventral segment 6 simple, about as long as 5.

*Hab.* ECUADOR (*Buckley*), Chillalocha, Loja (*Bourgeois*), San Lucas, Quito (*ex coll. Fry*), ?Guayaquil (*Rosenberg*); PERU, Jaen de Bracamoras (*Humboldt and Bonpland*), Mayabamba (*ex coll. Fry*), Nauta; BOLIVIA.

To judge from the labels on the numerous examples before me, two or more species are confused in collections under the name *A. bonplandi*, after the elimination of *A. rubripennis*; and it is doubtful if much reliance can be placed on some of the Ecuador locality tickets, as it is scarcely likely that an insect ranges from the sea-level at Guayaquil to the elevated region of Quito. A moderately large, black, thickly nigro-pilose\* form; the elytra red, with a common scutellar patch, an oblong patch at the shoulder (these markings sometimes coalescent posteriorly), two transversely-placed spots at the middle of the disc (often confluent and reaching the suture), a large spot below them, the sutural and apical margins, and the outer margin in part, black. In one or two examples the upper surface has a faint metallic tinge.

#### 10. *Astyus ceruleotinctus*, sp. n.

Moderately elongate, shining, nigro-pilose; nigro-ceruleous, sometimes with a greenish lustre, the basal joints of the antennae rufo-maculate; the elytra with an oval, posteriorly acuminate spot at the base, two transversely-placed patches before the middle (the inner one subtriangular or oval, and sometimes coalescent with the basal spot, the outer one extending forward along the outer margin to the shoulder), and a large, anteriorly subtruncate, complete or incomplete annulus before the apex, flavescent or red. Head small, somewhat deeply inserted into the prothorax, closely, finely punctate, hollowed in the middle between the eyes, the latter not very prominent; antennae moderately long in ♂, shorter in ♀. Prothorax transverse, finely punctate, the margins strongly reflexed. Elytra rather broad, rounded at the apex, closely, somewhat coarsely punctate, sometimes with a faint costa on the inner part of the disc. Legs slender.

\* Several examples in the Fry collection are completely abraded above.

♂. Ventral segment 5 deeply arcuato-emarginate, 6 conical, cleft down the middle to near the apex, leaving a narrow membranous space exposed. Tegmen with long, narrowly separated lateral lobes, which are somewhat spoon-shaped and flavo-ciliate at the tip. Penis-sheath rather slender, the outer portion straight, narrowly produced at the apex, the latter rounded.

♀. Ventral segment 6 short, simple.

Length 8-11, breadth 4-5 mm. (♂ ♀.)

Hab. COLOMBIA, Bogota; VENEZUELA; PERU.

Fifteen examples, including five males. A less robust, smaller insect than *A. bonplandi*, the surface constantly metallic, the elytral markings somewhat different, the sub-apical annulus always well defined, the legs more slender; the ♂ with the sixth ventral segment almost divided down the middle, and the lateral lobes of the tegmen undilated at the tip. Some of the specimens seen, both in the British Museum and in the Hope Collection at Oxford, are ticketed *A. (Dasys) bonplandi* or *A. rubripennis*, Latr.; the three at Oxford are without locality-label.

#### 11. *Astylus nigrolimbatus*, sp. n.

Moderately elongate, somewhat robust, shining, nigropilose; nigro-cæruleous, the basal joints of the antennæ rufo-maculate; the elytra with a space at the base (enclosing a transverse reddish spot), the suture thence to the tip, a triangular or transverse patch at about the middle of the disc (reaching the suture in one specimen), a rounded or sub-triangular patch below this, a patch at the apex, and the outer margin entirely of the ground-colour, the rest of their surface orange-yellow. Head, antennæ, and prothorax much as in *A. corrubotinctus*, and the elytra similarly sculptured.

♂. Ventral segment 1 hooked in the centre in front, 5 deeply, semicircularly emarginate, 6 long, conical, with an elongate-triangular notch at the tip, without trace of median division. Tegmen with long, flattened lateral lobes, which are rounded and flavo-ciliate at the apex. Penis-sheath almost straight, somewhat abruptly narrowed at the apex, the protruding membranous sac studded with minute points.

♀. Ventral segment 6 short, simple.

Length 7½-9½, breadth 3½-4½ mm. (♂ ♀.)

Hab. ECUADOR (ex coll. Fry: ♀); PERU [type] (ex coll. Fry: ♂ ♀).

Three males and two females. This insect resembles the smaller examples of *A. bonplandi*, from which it is separable

by the transverse reddish basal spot and the entirely bluish-black outer margin of the elytra. The ♂ has a similarly undivided sixth ventral segment; but the lateral lobes of the tegmen are shaped much as in the same sex of *A. ceruleotinctus*, which has an incompletely cleft sixth ventral segment in ♂. The above-mentioned colour differences also distinguish *A. nigrolimbatus* from the last-named insect, the outer limb of the elytra being partly flavescent or red in all the specimens of *A. bonplandi* and *A. ceruleotinctus* before me.

### 12. *Astylus bourgeoi*.

*Astylus bourgeoi*, Kirsch, Abhandl. Zool. Mus. Dresden, 1883, 69, no. 4, p. 11, t. 1, fig. 20; Bourg. Bull. Mus. Paris, 1911, p. 212.

*Astylus bisserguttatus*, Gorb. in Whymper's Great Andes, Suppl. App. pp. 52, 53, fig. (1891).

♂. Ventral segment 5 broadly arcuato-emarginate, 6 subtriangular, sulcate down the middle, notched at the tip. Tegmen narrow, with long, compressed, subcontiguous lateral lobes, which are ciliate and somewhat rounded at the tip. Penis-sheath with the outer portion almost straight, sulcate on the ventral aspect, abruptly narrowed at the apex.

♀. Ventral segment 6 short, simple.

*Hab.* COLOMBIA (ex coll. Sharp), Tuquerres (see Kirsch); ECUADOR, Quito, Cayambe, Mindo, Machachi, &c.

This variable insect is common at high elevations (8000–10,000 ft.) in Ecuador, many localities being given for it by Bourgeois and Gorbham, who figure similar well-marked examples. The latter have on each elytron a patch at the base, two transversely placed, oblong spots towards the middle, and a large annulus before the apex, flavescent or red, these markings being sometimes reduced to small spots, three of which represent the broken-up annulus. The inner submedian juxta-sutural spot is rarely wanting, and the elytra themselves are coarsely punctured. Two dissimilarly coloured males have been dissected, showing no variation in the armature.

### 13. *Astylus riveti*.

*Astylus riveti*, Bourg. Bull. Mus. Paris, 1911, p. 213.

Moderately elongate, shining, pilose, the hairs on the upper surface mostly black, with shorter decumbent greyish hairs intermixed, those on the under surface and legs cinereous; rufous, the basal joints of the antennæ entirely or in part, and the others at the extreme base, rufous; the

elytra greenish, nigro-ceruleous, or black, with an elongate streak at the middle of the base, two or three shorter streaks (including one near the outer margin) below this, and a large irregular annulus before the apex, all sometimes coalescent or partly obsolete, flavescent or rufo-testaceous; the head, prothorax, and scutellum closely, finely punctate, the elytra foveolato-punctate, with minute punctures in the narrow interspaces. Head small, the anterior portion short; antennae moderately long in ♂, shorter in ♀. Prothorax transverse, rounded at the sides in both sexes. Elytra subparallel to about the middle, the humeri tumid, the apical margin finely crenulate.

♂. Ventral segment 5 broadly arcuato-emarginate, 6 about as long as the lateral portions of 5, without groove, deeply, triangularly notched at the tip. Tegmen with long, compressed, narrowly separated, lateral lobes, which are rounded and flavo-ciliate at the apex. Penis-sheath pointed at the tip.

Length 6-7, breadth  $2\frac{3}{4}$ - $3\frac{1}{2}$  mm. (♂ ♀.)

Hab. ECUADOR, Tioloma, alt. 4263 metres (see, *Bourgeois* type), Cañar (*Rosenberg ex coll. Fry*: ♂ ♀).

The above description is taken from four males and one female from Cañar, which vary greatly in the development of the elytral markings. *A. riveti*, Bourg., from Tioloma, based on a single example (♀), seems to belong to the same species. The elytra in the insect before me are more coarsely punctured than in the allied *A. bourgeoisii*, Kusch (= *biser-guttatus*, Gorb.), a common species in the Andes of Ecuador, and equally variable in colour. In one example (♂) of the present insect the markings are entirely wanting on the basal half of the elytra, and in another (♀) the elytra (as in the type of *A. riveti*) are rufo-testaceous, with the sutural and outer margins, and four irregular angular patches black.

#### 14. *Astylus scarpustulatus*, sp. n.

Moderately elongate, shining, the elytra duller, sparsely nigro-pilose; nigro-rufous, the basal joints of the antennae partly red, the elytra black, each with six sharply defined orange-yellow spots—one, transverse, rather large, at the base, one small, beneath the humeral callus (not visible from above), one oblong, subquadrate, lateral, at about the basal third, one, small, oval, near the suture, before the middle, one, oblique, on the outer part of the disc, beyond the middle, and one, rather large, triangular, near the apex; the head and prothorax closely, finely, the elytra very coarsely, punctured.

Head rather small; antennæ short in both sexes. Prothorax transverse, rounded at the sides. Elytra moderately long, without costæ; the apices, ♂ ♀, rather narrow, rounded, feebly denticulate.

♂. Ventral segment 5 deeply arcuato-emarginate, 6 subconical, moderately long.

Length  $5\frac{1}{2}$ -6, breadth  $2\frac{1}{2}$ -2 $\frac{3}{4}$  mm. (♂ ♀.)

Hab. ECUADOR (Rosenberg).

One pair. Smaller than *A. bourgoisi*, Kirsch (= *bissexguttatus*, Gorb.), the head narrower, the antennæ much shorter, the elytral markings very different, the six orange-yellow spots (one of which is not visible from above) precisely similar in the two specimens seen. The male, not dissected, doubtless has a bilobed tegmen.

#### 15. *Astylus sexguttatus*.

*Astylus sexguttatus*, Kirsch. Abhandl. Zool. Mus. Dresden, 1888-89, no. 4, p. 11, t. 1, fig. 20.

♂. Ventral segment 5 broadly, semicircularly emarginate, 6 grooved down the middle. Tegmen with long, narrowly separated, rather broad lobes, which are ciliate at the tip. Penis-sheath attenuate, the apical portion beyond the aperture narrow.

Hab. COLOMBIA, Popayan and Jaumbala (see Kirsch).

There is a ♂ of this species in the Museum received in 1855, labelled with the MS. name *A. binaculatus*, Cnt., and as from Guatemala, the locality being certainly incorrect. A brilliant, nigro-ceruleous insect, with six sharply defined flavous spots on each elytron, arranged 1, 2, 2, 1. *A. michelisi*, Pic (1908), from Theresopolis, Brazil, seems to be more nearly allied to *A. sexguttatus* than to *A. sexmaculatus*, Perty, with which it is compared by its describer.

#### 16. *Astylus luteoguttatus*, sp. n.

Moderately elongate, narrow and subparallel-sided (♂), or broader (♀), shining, pilose, the hairs on the under surface and legs cinereous; greenish-aneous, the elytra and ventral surface often nigro-ceruleous, the latter with a spot at the base, two others along the sides (the anterior one sometimes obsolete), another, transverse, before the apex, and sometimes two additional spots along the disc near the suture orange-yellow or rufous, the basal joints of the antennæ rufo-maculate; sparsely, finely, the elytra moderately coarsely punctate. Head rather narrow, well developed behind the



eyes; antennae moderately long in ♂, shorter in ♀. Prothorax transverse, rounded at the sides in ♂, narrowed anteriorly in ♀. Elytra moderately long, the apices somewhat produced.

♂. Ventral segment 5 broadly arcuato-emarginate, 6 subconical. Tegmen with long, somewhat spoon-shaped, lateral lobes, their apices flavo-ciliate. Penis-sheath almost straight, subacuminate at apex.

Length 6-7, breadth  $2\frac{2}{3}$ - $3\frac{1}{4}$  mm. (♂ ♀.)

Hab. ECUADOR, Loja (Rosenberg), Macas (Buckley); PERU (ex colls. Murray and Fry; type).

Fifteen examples, ten of which are from Peru, females preponderating, three out of the four from Loja having two additional reddish spots on the disc of the elytra near the suture. Recognizable by the metallic green or bluish elytra, with sharply-defined orange spots, the two near the suture evanescent, and the two submarginal ones often very small or wanting. *A. luteoguttatus* is allied to the Colombian *A. savguttatus*, Kusch, differing from the latter in its much smaller size, less robust build, shorter elytra, &c. *A. latemaculatus*, Pic, from Peru, seems to be the nearest ally amongst those indicated by him in 1902.

#### 17. *Astylus luteicauda*, sp. n.

Moderately elongate, shining, pilose; nigro-aneous, greenish or aneous, the antennae wholly or in part, the apices of the elytra, the tibiae (except at the base), and tarsi testaceous or rufo-testaceous; the head and prothorax rather sparsely, the elytra very coarsely, punctate. Head elongated behind the eyes, and depressed in the middle between them, narrow in ♀, broader in ♂; antennae long and rather slender in ♂, short in ♀. Prothorax transverse, broad and with the sides rounded in ♂, rapidly narrowed from near the base in ♀. Elytra subparallel, sometimes with an indication of a faint costa on the disc, the apical margin obsolete crenulate.

♂. Ventral segment 5 broadly arcuato-emarginate, 6 conical, notched at the tip. Tegmen with long, compressed lateral lobes, which are rounded and flavo-ciliate at the tip. Penis-sheath straight, pointed at the apex.

Length 5-6, breadth  $2\frac{1}{3}$ - $2\frac{2}{3}$  mm. (♂ ♀.)

Hab. ECUADOR, Loja and Zaragura (Rosenberg ex coll. Fry).

Three females and two males. This insect must be nearly

related to, and perhaps a form of, the Peruvian *A. nigro-femoralis*, Pic\*, which is said to have the elytra luteo-trilineate at the base and luteo-maculate at the apex. The last-named species is compared by him with *A. pallipes*, Kirsch, from Ecuador. The longer head (especially in ♀), rufo-testaceous tibiae and tarsi, less coarsely punctured elytra, &c., separate *A. luteicorda* from *A. ricetti*, Bourg. in all its varieties. The ♂-armature is very similar in the two forms. *A. (Dasytus) xanthurus*, Blanch., from Maldonado, also has a yellowish tip to the elytra.

# 18. *Astylus variegatus*.

*Dasytus variegatus*, Germ. Ins. Spec. nov. p. 77 (1824); Cast. Hist. Nat. Col. i. p. 280<sup>2</sup>; Blanch. in Voyage d'Orbigny. p. 97<sup>2</sup>.

*Astylus variegatus*, Redt. Reise Novara, ii. p. 109<sup>4</sup>.

*Astylus variegatus*, Germ., var. *notatus*, Pic. L'Echange, xvii. p. 36 (1902)<sup>5</sup>.

♂ *Astylus atramaculatus*, Blanch., var. *revolti*, Pic, L'Echange, xvii. pp. 35, 36 (1902)<sup>5</sup>.

Var. Larger, the head and prothorax black, the elytra reddish, with the black median patch curving downwards posteriorly and coalescent with the sutural stripe; all the tibiae more or less curved in ♂.

♂. Anterior and intermediate tibiae curved. Ventral segment 5 broadly acuate-emarginate, 6 conical, undivided, deeply, triangularly notched at tip. Tegmen with very long, somewhat spoon-shaped lateral lobes, which are flavo-ciliate along their lower margin and at the apex. Penis-sheath stout, acuminate at apex.

♀. Ventral segment 5 feebly emarginate, 6 transverse.

Hab. BRAZIL: Rio de Janeiro; Minas Geraes, Pernambuco, São Paulo, Rio Grande; PARAGUAY, Sajucay (W. Foster); ARGENTINA, Corrientes<sup>6</sup>.

Apparently an abundant insect in many parts of Brazil, especially about Rio de Janeiro, and often found gregariously on flowers. The larger and darker form (? *revolti*, Pic) has the lateral lobes of the ♂-tegmen rounded at the tip (not incurved and truncate as in *A. atramaculatus*), and shaped as in *A. variegatus*. The head and prothorax are usually metallic in the latter. The subapical spot on the elytra is sometimes obsolete, sometimes (var. *notatus*) united with the one on the opposite elytron into a common transverse patch.

\* Mélanges exot.-entom. xii. p. 8 (Jan. 1915).

19. *Astylus atromaculatus*.

*Dasytes atromaculatus*, Blanch. in Voyage d'Orbigny, p. 97. t. 6. fig. 10.

*Astylus atromaculatus*, Blanch., var. *12-maculatus*, Pic, L'Echange, xvii. p. 36 (1902).

♂. Anterior and intermediate tibiae curved. Ventral segment 5 broadly arcuato-emarginate, 6 about as broad as long, deeply, triangularly notched at tip. Tegmen with long, broad lateral lobes, which are incurved at the apex within, subtruncate or blunt at the tip, and flavo-ciliate along their lower and apical margins. Penis-sheath stout, acuminate at apex.

♀. Ventral segment 5 feebly emarginate, 6 transverse.

Hab. ARGENTINA (O. W. Thomas), Mendoza, Catamarca (Mus. Brit.), Tucuman (x coll. Sharp); BOLIVIA (Mus. Oxon.).

A close ally of *A. variegatus*, but differing from it in having the prothorax densely clothed with adpressed cinereous hairs (in addition to the long, erect, bristly, black hairs) at the sides and down the middle, the cinereous pubescence extending over the greater part of the dorsum in the Tucuman examples; the median and postmedian black patches on the disc of each elytron oblique and less rounded, the median patch more or less constricted at the middle and sometimes divided into two spots (the six spots being arranged 2, 2, 1, 1 = var. *12-maculatus*, Pic); the tegmen of ♂ with incurved more or less truncate lateral lobes. Living examples of this insect have been captured at Durban and Pretoria, doubtless introduced with hay during the Boer War. Blanchard gave no locality \* for *A. atromaculatus*, but states that d'Orbigny found it in profusion on flowering lianas on the borders of woods. The Bolivian example in the Oxford Museum is labelled "*nigricollis* Hope."

20. *Astylus lineatus*.

*Anobium lineatum*, Fabr. Syst. Ent. p. 62<sup>1</sup>.

*Melyris lineatus*, Oliv. Ent. ii. 21, t. 1. fig. 6<sup>2</sup>.

*Dasytes lineatus*, Cast. Hist. Nat. Col. i. p. 281<sup>3</sup>; Blanch. in Voyage d'Orbigny, p. 98<sup>4</sup>.

*Astylus lineatus*, Reitt. Reise Novara, ii. p. 109<sup>5</sup>.

♂. Anterior and intermediate tibiae feebly curved. Ventral segment 5 deeply arcuato-emarginate, 6 conical, broader

The "Munich" Catalogue incorrectly gives Brazil.

than long, truncate at the tip. Tegmen with very long, rather narrow, lateral lobes which are slightly incurved and rounded at the apex, their lower and apical margins flavo-ciliate. Penis-sheath drawn out into a rather long slender point, which is thickened at the tip.

*Hab.* BRAZIL<sup>11</sup>, Rio Janeiro<sup>5</sup> (d'Orbigny<sup>4</sup>, C. Darwin, Fry, &c.).

A common insect in Brazil. The long series examined shows scarcely any variation in the peculiar elytral markings. The type in the Banksian collection is a male.

#### 21. *Astylus vittatus*.

*Astylus vittatus*, Gorb. Biol. Centr.-Am., Coleopt. iii. 1, pp. 127, 330, t. 7, fig. 9 (excl. example from Venezuela).

*Astylus vittatus*, Gorb., var. *chiriquensis*, Pic, Mélanges exot.-entom. xii. p. 7 (Jan. 1915).

♂. Elytra rounded at the apex. Ventral segment 5 deeply arcuato-emarginate, 6 moderately long, subconical, smooth, grooved down the middle posteriorly, and feebly notched at the tip. Tegmen bifurcate at apex, excavate at the tip above, the apical portion clothed with long, curled, blackish hairs. Penis-sheath acuminate at tip.

♀. Elytra obliquely subtruncate at the apex.

*Hab.* PANAMA, Chiriqui.

Found in abundance in Chiriqui. The variety has the flavous or reddish stripes (juxta-sutural and discal) on the elytra coalescent anteriorly, and the inner costa well defined. The metasternum is without tubercles in ♂. The sexes were not identified by Gorham. The unarmed apices of the elytra in ♀ separate *A. vittatus* from various similarly coloured forms.

#### 22. *Astylus pallipes*.

*Astylus pallipes*, Kirsch, Abhandl. Zool. Mus. Dresden, 1888-89, no. 4, p. 11, t. 7, fig. 22.

*Hab.* ECUADOR, Quito (*ex coll. Murray*), Loma de Canamballo [type].

A female example from Quito, in the Museum, from the Fry collection, is evidently referable to this species. It is black, with the antennæ in great part, the tibiae (except at the base), and tarsi testaceous; the elytra flavescens, with the suture, outer margin, two lines on the disc, and the tip black, the surface very coarsely punctured.

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23. *Astylus subgriseus*.*Astylus subgriseus*, Pic, L'Echange, xvii. p. 35 (1902).

♂. Moderately elongate, shining, thickly clothed with rather long, adpressed, cinereous pubescence intermixed on the upper surface with long, erect, black, bristly hairs; nigro-æneous or nigro-cæruleous, the basal joints of the antennæ partly red, the elytra with three narrow luteous stripes—one near the suture and extending along it at the tip, one running down the disc to the middle, and narrowing from the base, and one marginal, complete; the head and prothorax closely, very finely punctate, with coarser punctures intermixed, the elytra roughly punctured. Head well developed behind the eyes; antennæ moderately long. Prothorax a little broader than long, strongly rounded at the sides, and much narrowed behind. Elytra moderately elongate, subparallel, somewhat abruptly and obliquely narrowed at the tip, the apices narrow, the sutural angles sharp. Legs long; anterior and intermediate tibiæ curved; anterior trochanters drawn out into a long, blunt, spiniform process, which is finely denticulate beneath. Ventral segment 5 deeply arcuato-emarginate, 6 elongate, subconical. Tegmen with very long lateral lobes, which are subtruncate, slightly incurved, and flavo-ciliate at the tip. Penis-sheath abruptly acuminate at apex.

Length  $6\frac{1}{2}$ –7, breadth  $2\frac{1}{2}$ –3 mm.Hab. BRAZIL [type], Pernambuco (*Gounelle*).

Two males, each with the genital armature protruding. They are provisionally referred to the imperfectly described *A. subgriseus*, Pic, from Brazil, which is said to have three yellowish vittæ on the elytra, the one on the disc not reaching beyond the middle, and the suture black. It is the only species of the genus known to me with a long spiniform process extending outward from the anterior trochanters in ♂.

24. *Astylus cyanerythrus*.*Dasytes cyanerythrus*, Perty, Del. Anim. artic. Bras. p. 24, t. 6. fig. 14<sup>1</sup>.*Dasytes bifasciatus*, Cast. Hist. Nat. Col. i. p. 280<sup>2</sup>.*Dasytes rubrofasciatus*, Blanch. in Voyage d'Orbigny, p. 97<sup>3</sup>.

♂. Ventral segment 5 broadly arcuato-emarginate, 6 about as long as broad, membranous in the middle at the base, triangularly notched at the apex. Tegmen broad, the outer portion comparatively short, bluntly rounded, unemarginate,

and fringed with long hairs at the tip. Penis-sheath stout, abruptly acuminate and hooked at the apex.

♀. Ventral segment 6 short, simple.

*Hab.* BRAZIL<sup>1,2</sup>, Rio de Janeiro<sup>1</sup>; Santa Catharina, Bahia.

The seventeen examples of *A. cyanerythrus* before me (13 ♀♀, 4 ♂♂), belonging to the British Museum, or to the Hope Collection at Oxford, vary greatly in size (length 4½–10, breadth 2½–5½ mm.), and to some extent in colour. The two black patches on the disc of the prothorax are often transversely confluent, and the dark coloration sometimes extends over the whole dorsum, or leaves the basal margin only red; and the reddish submedian and subapical fasciæ on the elytra are very narrow in some examples, and not connected along the suture, differing in this respect from Perty's figure. Three of the specimens at Oxford are labelled with the MSS. names *annulatus*, K., *longicornis*, K., and *speciosus* respectively. A normal large ♂ (*speciosus* in Mus. Oxon.) has been dissected for examination of the mouth-parts and genital armature. It is possible that the smaller, darker, and more opaque form, also from Rio de Janeiro, may prove to be distinct? The synonymy quoted refers to the larger insect.

#### 25. *Astylus jatahyensis*.

*Astylus jatahyensis*, Pic, L'Echange, xvii. p. 35 (1902).

*Astylus jatahyensis*, var. *armidugoi*, Pic, Mélanges oxot.-entom. xii. p. 8 (Jan. 1915).

Moderately elongate, rather convex, shining, the elytra duller, clothed with erect, black bristly hairs intermixed with scattered cinereous pubescence, the vestiture of the under surface long, cinereous; black, the antennæ in great part, the prothorax with the entire margin, the elytra with the sutural and outer margins and a narrow 1-shaped streak running down the middle of the disc to near the apex, the coxæ, and legs (the tarsi, posterior femora, and posterior tibiae in part excepted) testaceous; the head closely, the prothorax rather sparsely punctured, the elytra irregularly asperate-punctate, with the interspaces alutaceous. Head rather short and broad, arcuately impressed in front; antennæ moderately long. Prothorax transversely convex, hollowed in the middle at the base, shallowly sulcate posteriorly. Elytra not very long, parallel, with or without two feeble costæ on the disc, the apices narrow, rounded.

♂. Ventral segment 5 feebly arcuato-emarginate, 6 short, triangularly notched at apex. Tegmen truncate at tip. Penis-sheath acuminate.

Var. The elytra testaceous, with two blackish, abbreviated or interrupted streaks, one near the suture, the other submarginal (var. *armitagei*, Pic).

Length  $4\frac{1}{4}$ – $5\frac{1}{2}$ , breadth 2– $2\frac{1}{4}$  mm. (♂.)

Hab. BRAZIL, Jatahy in Goyas (*Gounelle*), São Paulo (*ex coll. Fry*).

Pic's type, to judge from the brief note about it, would appear to want the narrow !-shaped streak extending down the disc of each elytron, conspicuous in the two males from Jatahy before me. The variety, represented by two examples from São Paulo in the Fry Collection, agrees with his brief diagnosis of *A. armitagei*.

## 26. *Astylus vittaticollis*.

*Dasytes vittaticollis*, Blanch. in Voyage d'Orbigny, p. 98 (1843).

? *Melyris quadriteniata*, Er. Archiv für Naturg. xiii. 1, p. 84 (1847).

♂. Antennæ rather slender, elongate, much longer than in ♀. Ventral segment 5 deeply arcuato-emarginate, 6 moderately long, subconical, with a narrow, deep, triangular notch at tip. Tegmen with long lateral lobes, which are rounded and clothed with long hairs at the apex. Penis sheath, as seen in profile, obliquely dilated and subsecuriform at tip.

♀. Ventral segment 5 feebly emarginate, 6 shaped very much as in ♂.

Hab. BOLIVIA (*Mus. Brit.*: ♂ ♀), Chuquisaca [type]; ? CHILE (*Germain, ex coll. Fry*: ♂ ♀).

Very like the variable *A. quadrilineatus*, Germ., but with much more finely punctured elytra, the apices without tooth at the sutural angle in either sex; the prothorax (in fresh specimens) with a line down the middle and a space along the sides closely cinereo-pubescent, much as in *A. atro-maculatus*, Blanch.; the antennæ long and slender in ♂, with the basal joints only testaceous; the genital armature very different.

Five specimens are before me, including a pair from Bolivia, a pair labelled "Chile" (a locality requiring confirmation), and a ♂, belonging to the Oxford Museum, labelled "*quadrivittatus*, Chevr., Andes." *Melyris quadriteniata*, Er., from Peru, may be based upon a slightly worn example of the present species, the definition "elytris apice integris, crebre punctatis, subrugulosis" agreeing with *A. vittaticollis*.

27. *Astylus quadrilineatus*.

*Dasytes quadrilineatus*, Germ. Ins. Spec. nov. p. 76 (1825)<sup>1</sup>; Blanch. in *Voyage d'Orbigny*, p. 98<sup>2</sup>; Cast. Hist. Nat. Col. i. p. 261<sup>3</sup>.

♂. Antennæ wholly or in part rufo-testaceous, moderately long, considerably longer than in ♀. Elytra more or less sinuate at the tip, and with the sutural angles almost as acute as in ♀. Ventral segment 5 deeply areolato-emarginate, 6 barely as long as 5, subconical, feebly notched at tip. Tegmen more or less emarginate or bilobed, and clothed with long blackish hairs at apex. Penis-sheath gradually narrowed or acuminate at tip.

♀. Ventral segment 5 feebly emarginate, 6 short.

Hab. BRAZIL<sup>1,2</sup>, Santa Catharina (*ex coll. Foy*: ♀), Rio Grande; URUGUAY, Maldonado<sup>1</sup>, Monte Video (*C. Darwin*); ARGENTINA (*O. W. Thomas*), Santa Fé and Bahía Blanca (*C. Darwin*), Buenos Ayres<sup>1</sup>; PATAGONIA<sup>2</sup>.

A variable insect, if the specimens before me all belong to one species. The reddish or flavescent marginal and discoidal vittæ of the elytra are sometimes coalescent at the tip and the discoidal one may be reduced to a narrow incomplete line. Four males have been dissected, showing some variation in the form of the tegmen, which in a large example from Buenos Ayres has a short lobe on each side at tip. Two small males from Monte Video, with the sutural angles of the elytra obtuse and the tegmen rounded at apex, may belong to a different species? The length varies from 6-9 mm. The general colour may be bluish-green, green, nigro-cæruleous, or brassy.

28. *Astylus correptus*, sp. n.

Elongate, moderately broad, shining, nigro-pilose, with short, adpressed, cinereous hairs intermixed; black, the elytra (the humeri, basal portion of the suture, and apical margin excepted) brown; closely, minutely, the elytra finely, irregularly punctate. Head hollowed on each side anteriorly; antennæ strongly serrate, short in ♀, a little longer in ♂. Prothorax broader than long, narrowed anteriorly in both sexes, hollowed in the middle at the base. Elytra long, costate laterally to near the apex, and obsolete bicostate on the disc; in ♂ somewhat rounded at the sides, and with the apical portion narrow and considerably produced; in ♀ subparallel to near the tip, and with the humeri much swollen.

♂. Anterior tarsi with joints 2 and 3 obliquely dentate and 4 angulate, and the intermediate tarsi with joint 3



dentate and 4 angulate at the inner apical angle. Ventral segment 5 arcuato-emarginate, 6 conical. Tegmen flattened, simple, narrow, rounded and entire at the tip. Penis-sheath slender, the outer portion straight, abruptly pointed at the apex.

Length  $9\frac{1}{2}$ – $10\frac{1}{2}$ , breadth  $4\frac{1}{10}$  mm. ( $\delta$  &  $\text{f}$ .)

*Hab.* COLOMBIA [ $\text{f}$ ] and VENEZUELA [ $\delta$ ] (*Mus. Brit.*).

One pair, acquired by the Museum in 1844, the  $\delta$  bearing an inapplicable MS. name. The dissimilarity in the shape of the elytra in the two sexes, the elytra themselves being sharply costate laterally in both of them, the peculiarly formed anterior and intermediate tarsi of the  $\delta$  (suggestive of the Palearctic genus *Henicopus*), and the simple, narrow tegmen in the same sex, are characters of insufficient importance to remove *A. correptus* from *Astylus*. The  $\delta$ , which must be taken as the type, has the facies of an *Omophilus*.

#### 29. *Astylus forcipatus*, sp. n.

Moderately elongate, narrow, feebly shining, clothed with long, erect, bristly hairs intermixed with adpressed, scattered, cinereous pubescence, the vestiture of the under surface long, cinereous; black, with a faint brassy tinge, the antennæ, tibiae, and tarsi testaceous; the elytra flavous, each with two broad vittæ extending from the base to the apical declivity (one dorsal, the other submarginal), and a spot before the apex, black; closely, finely, the dark portions of the elytra rugulose, punctate, the punctures on the flavous portions conspicuous, and uniserially arranged within the dorsal and marginal ridges. Head broad, the eyes large, prominent; antennæ moderately long. Prothorax transverse, narrowed anteriorly, canaliculate on the disc. Elytra parallel, bicostate, the inner costa stout, the submarginal one narrow, the apices obtuse.

$\delta$ . Terminal dorsal segment of abdomen with a long, stout, flattened, slightly sinuate process on each side, which is blunt at the tip and clothed with very long blackish hairs. Ventral segment 5 shallowly arcuato-emarginate, 6 short, deeply, triangularly excised. Tegmen narrow, truncate at the apex. Penis-sheath flattened, acuminate and somewhat spoon-shaped at the tip.

Length  $4\frac{1}{2}$ – $5\frac{1}{2}$ , breadth  $1\frac{3}{4}$ –2 mm.

*Hab.* BRAZIL (ex coll. *Fry*).

Two males, injured by pinning, and both having the genital armature extruded. A small, narrow, parallel-sided

insect; the elytra flavous, with two broad vittæ (discoïdal and submarginal), and a spot before the apex, black; the antennæ, tibiæ, and tarsi testaceous; the terminal dorsal abdominal segment with a long process on each side. *A. forcipatus* is not unlike the insect here identified as *A. jatahyensis*, Pic, and is somewhat similarly coloured—except that the prothorax is wholly black and the subapical spot on the elytra is testaceous (instead of black)—differing from the latter in having a rougher, less convex prothorax, a stout costa on the disc of the elytra, &c.\*

### 30. *Astyus convexus*, sp. n.

Elongate oval, rather convex, very shining, sparsely pilose; metallic blue, the basal joints of the antennæ in great part rufi-testaceous, the elytra testaceous, with the suture narrowly and two broad stripes on the disc (united posteriorly in one specimen) cæruleous, the legs black; the head closely, finely, the prothorax sparsely, somewhat coarsely, and the elytra very coarsely, punctate. Head rather broad; antennæ (♂) long and comparatively stout, the joints longer than broad, in ♀ a little shorter. Prothorax transverse, ample, rounded at the sides, the margins strongly reflexed. Elytra moderately long, somewhat acuminate at tip, without trace of costæ, the humeri obtuse. Wings wanting. Legs moderately elongate.

♂. Anterior tarsi with joint 2 drawn out into an oblique tooth, and 3 angulate, at the inner apical angle. Ventral segment 5 deeply arcuato-emarginate, 6 short, notched at tip. Penis-sheath drawn out into a long point at apex.

Length 5-5½, breadth 2½ mm. (♂ ?.)

Hab. PERU, Chanchamayo (*Thunni*).

One male and two females. A rather convex, apterous, metallic-blue insect, with testaceous, cæruleo-bilineate elytra. Not unlike *A. pallipes*, Kirsch, from Ecuador, but more convex, the antennæ longer and stouter, the prothorax more ample and with strongly reflexed margins, the humeral callus obsolete, the legs black, the wings (so far as can be seen without opening the elytra) wanting. This species may have to be removed from *Astyus*. The long antennæ, &c., separate *A. convexus* from the Chilean genus *Arthrobrachus*.

\* In the Fry Collection there is a damaged ♂ of an allied larger form from La Paz, Bolivia, with entirely testaceous legs, the abdominal processes wanting, &c. It cannot be referred to *A. bolivianus* or *exclamatoria*, Pic, from the same country.

31. *Astylus curvidens*, sp. n.

Elongate, shining, clothed with long, erect, black, bristly hairs intermixed with scattered adpressed cinereous pubescence, the vestiture of the legs and under surface cinereous; black, the basal joints of the antennæ partly red, the elytra with an oblong streak at the base, the outer margin to near the tip, and two stripes on the disc (one near the suture, abbreviated anteriorly, the other abbreviated behind and placed a little exterior to the basal patch, with which it is sometimes connected anteriorly), the sutural and marginal stripes transversely coalescent just before the apex, flavous or luteous; the head and prothorax densely, finely punctate, the latter with coarser punctures intermixed, the elytra roughly punctured. Head small, subrostrate, the eyes large; antennæ short, serrate, joints 7-10 about as broad as long, in ♂, transverse in ♀. Prothorax narrowed anteriorly. Elytra long, subparallel, costate from the humeral callus to near the apex, and also with an anteriorly evanescent costa on the disc; the apices in ♂ distinctly sinuate and with the sutural angle sharply produced, in ♀ very deeply emarginate, with the sutural and outer angles each produced into a long curved tooth, those at the sutural angles overlapping, the outer one very strongly arcuate.

♂. Metasternum with two compressed, conical, tuberculiform prominences in the middle behind. Ventral segment 5 deeply arcuate-emarginate, 6 long, subcylindrical (with the dorsal portion forming a long tube, which is cleft laterally at the tip). Tegmen feebly bifurcate at tip, deeply sulcate at the apex above, the apical portion thickly clothed with long, curled, blackish hairs. Penis-sheath sharply pointed, curved upward at the tip,

Length 7-8½, breadth 2½-3 mm. (♂ ♀.)

Hab. VENEZUELA, Merida (Rosenberg: ♂ ♀); ? PERU (ex Deyrolle: ♂).

Three males and four females, the Peruvian habitat requiring confirmation. Extremely like *A. vittatus*, Gorb., from Chiriqui, but easily separable therefrom by the sexual characters: the ♂ with two compressed tubercles on the metasternum and the terminal abdominal segment elongated and subcylindrical; the ♀ with a very long tooth on each side of the apical emargination, the outer tooth arcuate, the inner one overlapping the corresponding tooth on the opposite elytron.

32. *Astylus antillarum*.

*Astylus antillarum*, Gorb. P. Z. S. 1898, p. 328, t. 27. fig. 7 (♂).

♂. Metasternum with two, curved, outwardly-directed, dentiform processes arising from a tumid space in the middle behind. Ventral segment 5 deeply arcuato-emarginate, 6 long, compressed (subcylindrical as seen in profile with the terminal dorsal segment).

Hab. ANTILLES, St. Vincent.

Described from a single pair—the ♂ now in the British Museum, the ♀ having passed into Pic's collection, from that of Gorham. The ♀ has the apices of the elytra deeply excised, as in the same sex of the allied forms. The spots are too red in the published figure.

33. *Astylus gorhami*.

♂. *Astylus gorhami*, Pic, Mélanges exot.-entom. xii, p. 8 (Jan. 1915).

Elongate, moderately shining, clothed with long, erect, black bristly hairs intermixed with scattered fine, adpressed, cinereous pubescence, the latter somewhat conspicuous along the elytral suture in ♀, the vestiture of the legs and under surface long, cinereous; black, the antennal joints more or less rufescent externally or at their base, the elytra each with a pyriform patch on the disc at the base, a mesially-constricted, apically widened, elongate streak on the disc below this, a subquadrate patch near the tip, and the outer margin in great part, orange-yellow; the head and prothorax densely, finely punctate, the latter with coarser, punctures intermixed, the elytra roughly punctured, smoother in the depressed juxta-sutural area in ♀. Head long, narrow, subrostrate; antennae short, joints 7-10 transverse in ♀. Prothorax about as long as broad, narrowed anteriorly. Elytra long, sharply margined, costate laterally from the humeral callus to the common transverse apical depression, and with a faint costa on the disc also, the space between this and the suture and another within the outer ridge longitudinally depressed, conspicuously so in ♀; the apices blunt or subtruncate in ♂, and deeply semicircularly excavate (the sutural and outer angles thus appearing sharply dentate) in ♀.

♂. Metasternum with two compressed, curved, outwardly-directed dentiform processes arising from a tumid space in the middle behind. Ventral segment 5 as long as 3 and 4

united, very deeply emarginate, 6 long, compressed. Tegmen slightly dilated and simply bifurcate at the tip, the apex set with numerous long, projecting, blackish hairs. Penis-sheath acuminate, curved upward at tip.

♀. Ventral segment 5 triangularly emarginate at tip, 6 short.

Length  $7\frac{1}{2}$ –8, breadth  $3$ – $3\frac{1}{2}$  mm. (♂ ♀.)

Hab. ANTILLES, St. Vincent (*H. H. Smith, Lansdown Guilding*), and Union Island in the Grenadines (*H. H. Smith*).

Redescribed from five males and four females belonging to the British Museum or to the Hope Collection at Oxford, including a ♂ from St. Vincent found by *Lansdown Guilding* and a ♀ from Union Island, the others unlabelled, but all probably from St. Vincent. The specimen from the Grenadines, labelled *A. antillarum*, var.?, by *Gorham*, was not mentioned by him in his description of that species. It is strange that there should be two such closely allied forms in a small island like St. Vincent, but there is nothing intermediate in the series of *A. gorhami* before me, *A. antillarum* having the elytra spotted much as in *A. octopustulatus*. The emarginate, bidentate apices of the elytra is a character peculiar to the ♀ of these three insects, all of which have a bituberculate metasternum in ♂.

#### 34. *Astylus amabilis*.

? *Astylus amabilis*, Pic, L'Echange, xvii. p. 35 (1902).

Elongate, shining, clothed with long, erect, black bristly hairs intermixed with scattered adpressed cinereous pubescence, the vestiture of the legs and under surface cinereous; black, the basal joints of the antennæ partly or almost entirely red, the elytra with a broad or moderately broad stripe extending down the disc to the apical depression, a transverse subapical patch, and the outer margin to near the apex, these markings sometimes coallescent posteriorly, flavous or orange-yellow; the head and prothorax closely, finely, the elytra roughly, punctured. Head small; antennæ short. Prothorax narrowed anteriorly. Elytra long, subparallel, costate laterally from the humeral callus, and with an indication of a faint costa on the disc; the apices in ♂ freely subtruncate or rounded, in ♀ deeply emarginate, with the sutural angle drawn out into a long, narrow, nearly straight tooth and the outer angle into a shorter acutely

triangular one, the sutural tooth slightly overlapping the one on the opposite elytron.

♂. Metasternum with two compressed conical tubercules in the middle behind. Ventral segment 5 deeply arcuato-emarginate, 6 elongate, compressed.

Length  $6\frac{1}{2}$ –8, breadth  $2\frac{1}{2}$ – $3\frac{1}{4}$  mm. (♂ ♀.)

*Hab.* COLOMBIA (ex coll. Fry), Magdalena (Mus. Brit.).

A mainland form of the Antillean *A. gorhami*, Pic, the markings on the disc of the elytra united into an almost straight vitta, the tooth at the sutural angle in the ♀ elongated and longer than the outer one, which is also more acute. Three males and two females seen, one female bearing the MS. name *Dasytes spinosus*, Guér., and one male, ex Deyrolle, labelled *D. amabilis*, Dej. The apices of the elytra are truncate in two of the males and rounded in the third. This insect seems to be referable to the species briefly alluded to by Pic under the name *A. amabilis*: he describes the elytra as having a complete pale discal band and a narrow black tip. His type, from Colombia, was also obtained from Deyrolle, and under the same MS. name.

### 35. *Astylus octopustulatus*.

*Astylus octopustulatus*, Gorb. Biol. Centr.-Am., Coleopt. iii. 1, p. 330, t. 12, fig. 25 (♂).

♂. Elytra truncate at apex. Metasternum with the small dentiform processes arising from a tumid space in the middle behind. Ventral segment 5 very deeply emarginate, 6 long, compressed. Tegmen simply bifurcate and clothed with long, projecting, blackish hairs at tip. Penis-sheath drawn out into a long point at the apex.

♀. Elytra deeply emarginate at apex, the sutural and outer angles sharply dentate.

*Hab.* PANAMA, Chiriqui.

Gorham correctly identified the sexes of this insect, but he overlooked the metasternal dentiform prominences of the ♂, which are wanting in the same sex of his *A. vittatus*.

### 36. *Astylus lehani*, sp. n.

*Dasytes lehani*, Dej. Cat. 3rd edit. p. 124 (1837).

Elongate, narrow, shining, clothed with long, erect, black, bristly hairs intermixed with scattered adpressed cinereous pubescence, the vestiture of the legs and under surface

cinereous; black, the basal joints of the antennæ red, the elytra each with four longitudinally arranged spots on the disc—one at the base, acuminate-oval, one, oblong or slightly oblique, one, rounded or subtriangular, and one, transverse, subapical, the anterior two sometimes coalescent—and the outer margin to near the apex, flavous or orange-yellow; the head and prothorax closely, finely, the elytra roughly, punctured. Head small, the eyes rather large; antennæ short. Prothorax narrowed anteriorly. Elytra long, subparallel, sharply costate from the humeral callus downward, and also feebly costate on the disc; the apices in ♂ feebly truncate or rounded, in ♀ more or less emarginate, and with the sutural and outer angles dentiform.

♂. Metasternum with two small, compressed, subcontiguous tubercles in the middle behind. Ventral segment 5 deeply arcuato-emarginate, 6 long, compressed. Tegmen simply bifurcate and clothed with long, projecting blackish hairs at the tip. Penis-sheath drawn out into a long, slender point at the apex.

Length  $5\frac{1}{2}$ –6, breadth  $2\frac{1}{8}$ – $2\frac{1}{2}$  mm. (♂ ♀.)

Hab. COLOMBIA (*Mus. Brit.*), Carthagona (*Dejean Cat.*); VENEZUELA (*ex coll. Fry*).

Described from eight examples, four of each sex. The teeth at the apex of the elytra in ♀ vary in length, and the first and second spots on the disc are confluent in two of the specimens of that sex before me. This is the undescribed smaller Colombian form alluded to by Gorham in his description of *A. octopustulatus*. There is nothing intermediate in the long series of the latter examined, and the present insect may be distinguished from it by the elongated first and second spots on the disc of the elytra, approaching *A. gorhami* in this respect. The genital armature is very similar. *A. lebasii* is not mentioned by Pic in any of his various scattered papers on *Astylus*.

### 37. *Astylus hamatilis*, sp. n.

Elongate, narrow, shining, clothed with erect, black, bristly hairs intermixed with scattered fine adpressed cinereous pubescence, which is denser on the prothorax and elytral suture of ♀, the vestiture of the legs and under surface cinereous; black, the basal joints of the antennæ partly red, the elytra each with four longitudinally-arranged marks on the disc—one, pyriform, at the base, one, angulate or A-shaped, one, rounded or subtriangular (connected out-

wardly in one specimen with the angular mark), and one, transverse, subapical—and the outer margin to near the apex, orange-yellow, the head and prothorax closely, finely punctate, the latter with coarser punctures intermixed, the elytra roughly punctured. Head narrow; antennæ short, joints 7-10 transverse in ♀. Prothorax narrowed anteriorly. Elytra long, subparallel, costate laterally from the humeral callus to the apical declivity, and with an anteriorly evanescent costa on the disc; the apices narrow and rounded or subtruncate in ♂, a little wider, feebly emarginate, and with the sutural angle angularly dilated inwards so as to overlap the one on the opposite elytron, in ♀.

♂. Metasternum with two compressed conical tubercles in the middle behind. Ventral segment 5 deeply arcuato-emarginate, 6 long, compressed (subcylindrical as seen in profile with the terminal dorsal segment). Tegmen narrow, subtruncate at tip, which is slightly hollowed dorsally and clothed with long blackish hairs. Penis-sheath drawn out into a slender, feebly curved point.

Length  $6\frac{1}{4}$ - $6\frac{1}{2}$ , breadth  $2\frac{1}{3}$ - $2\frac{1}{2}$  mm. (♂ ♀.)

Hab. VENEZUELA (ex coll. Fry).

Three males and one female, varying a little in the development of the elytral markings, two of them being coalescent in one specimen. Near *A. octopustulatus*, Gohl., the spots differently shaped, the second one on each elytron hooked, the tooth at the outer angle in the ♀ reduced to a feeble angulation, the dentiform sutural angle directed inwards and overlapping the one on the opposite wing-case.

### 38. *Astylus imbricatus*, sp. n.

♀. Black, the elytra with three rather broad flavous vitæ, the two on the disc connected anteriorly, the sutural and marginal ones broadly coalescent before the tip (leaving the apical margin narrowly black), and the median one slightly constricted posteriorly; the apices of the elytra sinuato-truncate, the sutural angle sharp and overlapping the one on the opposite wing-case; the elytral bicostate and rather coarsely punctate.

Length  $5\frac{1}{4}$ , breadth 2 mm.

Hab. VENEZUELA (ex coll. Fry).

One female. Smaller and narrower than the smallest example of *A. vittatus*, var. *chiriquensis*, the apices of the elytra truncate, with inwardly produced, acute, overlapping



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sutural angles. The male probably has tubercles on the metasternum, these being present in the same sex of the nearly allied *A. curvidens*. The Venezuelan insect referred by Gorham to his *A. vittatus* may belong here?

39. *Astylus laticauda*, sp. n.

♀. Black, the elytra with an oblong spot at the base, a small spot on the disc at about one-third from the tip, a transverse patch midway between the latter and the apical margin, and the outer margin to about the middle, orange-yellow; the elytra bicostate, the apices broadly sinuato-truncate, with the sutural angle produced inwardly into a rather long tooth and the outer angle rounded; the other characters as in the same sex of *A. gorhami*, *A. antillarum*, *lebasii*, &c.

Length 7, breadth 3 mm.

*Hab.* VENEZUELA (*ex coll. Fry*).

One worn female, too different to be included under any of the allied forms as a colour-variety (the third spot on the elytra small and the second wanting altogether), owing to the broadly sinuato-truncate apices of the elytra and the inwardly-produced dentiform sutural angles.

Alphabetical list of species and varieties of *Astylus* enumerated in the present paper: the synonyms and varietal names are printed in italics, and the numbers of the species are placed in brackets after their respective names, an asterisk indicating the new form:—

<i>affinis</i> (2).	<i>cyanerithrus</i> , 24.
<i>amabilis</i> , 34.	<i>12-maculatus</i> (19).
<i>annulatus</i> (24).	<i>fasciatus</i> (5).
<i>antillarum</i> , 32.	<i>fenestratus</i> (7).
<i>antis</i> , 5.	<i>flavofasciatus</i> (5).
<i>armatipes</i> (25).	* <i>forcipatus</i> , 29.
<i>atromaculatus</i> , 19.	<i>gnyi</i> , 2.
<i>cahinus</i> , 7.	<i>gorhami</i> , 33.
<i>bifasciatus</i> (24).	* <i>hamatostictus</i> , 4.
<i>baso-guttatus</i> (12).	* <i>hamatilis</i> , 37.
<i>berplandi</i> , 9.	* <i>imbricatus</i> , 38.
<i>bourgeoisii</i> , 12.	<i>intermedius</i> (1).
* <i>caeruleotinctus</i> , 10.	<i>jatahyensis</i> , 25.
<i>chiriquensis</i> (21).	* <i>laticauda</i> , 39.
* <i>convexus</i> , 30.	* <i>lebasii</i> , 36.
* <i>correptus</i> , 28.	<i>lineatus</i> , 20.
* <i>curviblenis</i> , 31.	<i>longicornis</i> (24).

*luteicauda, 17.	rubripennis (9).
*luteoguttatus, 16.	rubrofasciatus (24).
*nigricollis (19).	rugosus (1).
*nigrolimbatus, 11.	sexguttatus, 15.
notatus (18).	sexmaculatus, 3.
oetopustulatus, 35.	*secpustulatus, 14.
pallipes, 22.	speciosus (24).
pictus (3).	spinosus (34).
porrectus (2).	splendidus, 6.
quadrilineatus, 27.	subgriseus, 23.
quadridentatus (26).	trifasciatus, 1.
quadrivittatus (26).	variegatus, 18.
recoili (18).	vittaticollis, 26.
riveti, 13.	vittatus, 21.
rubripennis, 8.	

Horsell, Aug., 1918.

XXXIII.—On some External Characters of Ruminant Artiodactyla.—Part IV. The Reduncinae (Cervicaprinae) and Apycerinae. By R. I. Pocock, F.R.S.

As in the previous papers of this series published in the 'Annals' for June, August, and September of this year, the pagination subjoined to the specific headings refers to my treatise on the Cutaneous Glands of the Ruminants printed in the Proc. Zool. Soc. for 1910.

Subfamily *REDFUNCIÆ* (olim *Cervicaprinae*).

Genus *PELEA*.

*Pelea capreolus*, Bechst. (p. 911).

A second specimen of this species, which came into my hands since 1910, enables me to confirm in every particular the characters of the genus, based on external features, which I pointed out in that year.

Since this specimen, like the first, had no trace of inguinal glands, I think it may be assumed that Owen's statement as to their presence was false.

The only fact I have to add to my original description is that the false hoofs on both the fore and hind feet are united across the middle line.

Genus *ELEOTRAGUS*, Gray.

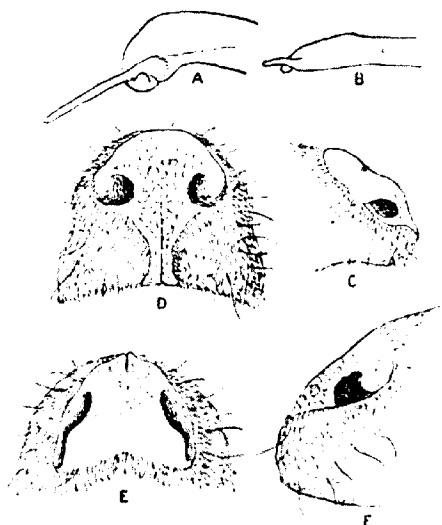
*Eleotragus arundinum*, Bodd.

In 1910 I was not in a position to incorporate an account

of this species in my paper. The examination, however, of an adult female specimen in 1911 revealed some interesting features connected especially with the rhinarium and inguinal glands.

The *rhinarium* (fig. 1, C), as in all the Reduncinæ, has a narrow philtrum, but it recalls that of *Pelea* in the backward extension of its upper surface a long way beyond the posterior angle of the nostrils. This area of it, however, is not so inflated as in *Pelea*.

Fig. 1.



- A. Extremity of penis of *Kobus defassa* from the left side.
- B. The same of *Redunca redunca*.
- C. Rhinarium of *Eleotragus nrundinum* from the right side.  $\times \frac{1}{2}$ .
- D. The same of *Redunca redunca* from the front.  $\times \frac{1}{2}$ .
- E. The same from above.  $\times \frac{1}{2}$ .
- F. The same from the left side.  $\times \frac{1}{2}$ .

As in *Pelea*, there is no trace of preorbital glands, as Owen stated. In the feet the interdigital web is naked, as in *Pelea*, but there is no trace of pedal glands, and the false hoofs are not united, but separated by a narrow tract of naked skin. The feet, indeed, resemble those of *Adenota* and of most examples of *Redunca*.

Owen correctly recorded the presence of inguinal glands in this species, but gave no particulars. They are, as a matter of fact, peculiar. On each side of the mammæ, which are arranged in a quadrilateral, and rather far out from them, is a large orifice opening backwards and inwards, not outwards, and this leads into a pouch about 3 inches deep which runs obliquely forwards and outwards along the depression between the thigh and the abdomen. The area round the mammæ and the glands is naked, and the secretion of the glands has a starchy smell, like flour-paste.

For information as to the structure of the penis, see under *Redunca* (q. v. infra).

On the strength of the information regarding the rhinarium and inguinal glands I gave him in 1914, Mr. Lydekker (Cat. Ung. Mamm. ii. p. 203) granted subgeneric rank to *Eleotragus*. But, as I pointed out to him at the time, the characters which distinguish the type-species of *Eleotragus* from that of *Redunca* (olim *Cervicapra*) are quite sufficient for generic admission. The structure of the rhinarium affiliates *Eleotragus* with *Peleu*, and distinguishes it from *Redunca*. On the other hand, the absence of pedal glands and the presence of inguinal glands show affinity to *Redunca* and departure from *Peleu*. In the direction of the inguinal glands and in the presence of only a single pair, representing the shallow anterior pair of *Redunca*, *Eleotragus* is distinct from that genus.

#### Genus REDUNCA (olim *Cervicapra*)<sup>\*</sup>.

##### *Redunca redunca*, Pall. (p. 913).

A male example of this species from the Sudan (*G. Blaine*), and probably referable to the race described as *coltoni*, resembles in every particular, so far as the characters under discussion are concerned, the examples of the typical race of the species from Senegambia which I described in 1910.

The rhinarium (fig. 1, D, E, F), viewed from the front, has a convex upper margin; the nostrils are about as widely separated as in *Eleotragus*, and, as in that genus, there is scarcely a trace of naked skin below them: the philtrum is as wide above as the internarial septum, narrow inferiorly, and expands slightly where it passes into the gum of the upper lip; it is mesially grooved up to the level of the lower

<sup>\*</sup> On the evidence supplied by Palmer, I follow Lydekker in adopting *Redunca* for *Cervicapra*, the latter being a synonym of *Antelope*.

border of the nostril, but there is no depression on the antero-superior surface of the rhinarium; the posterior edge of the upper surface of the latter is only slightly angular, the hairs of the muzzle extending in a nearly straight line across between the posterior angles of the nostrils. It is in this respect that the rhinarium differs so markedly from that of *Eleotragus*.

There is a bare patch of skin below the ear\*.

Of the two pairs of *inguinal glands*, the anterior consists on each side of a wide but shallow pouch, and the posterior of a subcylindrical but dilatable pouch about 2 inches deep, the yellow secretion having a starchy smell.

Of the *pedal glands* no vestige remains; on the fore foot the false hoofs are united at the base, on the hind foot they are separated by a narrow strip of naked skin.

The *glans penis* (fig. 1, B) is slightly thickened towards the extremity, then gradually narrowed to a blunt point; the urethral canal is produced into a short slender tube overlapping the tip of the penis to a small extent. This penis is very like that of *Eleotragus arundinum* described and figured by Lönnberg (Ark. Zool. Stockholm, (5) v. no. 10, p. 6, fig. 5, 1909), except that the urethral process appears to be a little longer.

#### Genus ADENOTA, Gray.

##### *Adenota kob*, Erxl. (p. 915).

I have nothing to add to the description of this species published in 1910; but it is important to recapitulate the characters upon which the genus should be sustained, although Mr. Lydekker regarded it merely as a subgenus of *Kobus*.

It resembles *Kobus* in the structure of the rhinarium (*q. v. infra*) and in possessing a tufted instead of a bushy tail like that of *Pelea* and *Redunca*. It differs from *Kobus* in having a preorbital gland, consisting of a thickened area of skin, and a single pair of inguinal glands. In one of the specimens described in 1910 I recorded the presence of an additional vestigial or rudimentary inguinal gland, lying far out away from the mammae, on the right side. This

\* This patch was absent in the two examples of the typical race of this species described in 1910. This statement was evidently overlooked by Mr. Lydekker in 1914, when he cited the presence of this patch as one of the features distinguishing *Redunca* from *Kobus*. The naked patch is not glandular, but consists of very thin skin. Its function is unknown.

gland clearly represents one of the anterior pair present in *Redunca*. This very interesting fact shows that in *Adenota* representatives of the posterior pair of inguinal glands seen in *Redunca* are retained, whereas *Eleotragus* retains the homologues of the anterior pair of *Redunca*.

Genus *Kobus*, Smith.

*Kobus defassa*, Rüppell (p. 916).

In 1910 I was unable to publish reliable information as to the cutaneous glands of any species of the genus *Kobus*, having only the dried skin of the head of *K. defassa* and dried feet of *K. marie* for examination. Since that date I have been able to examine an adult male and female of *K. defassa* and an adult male hybrid between *K. defassa* and *K. ellipsiprymnus*.

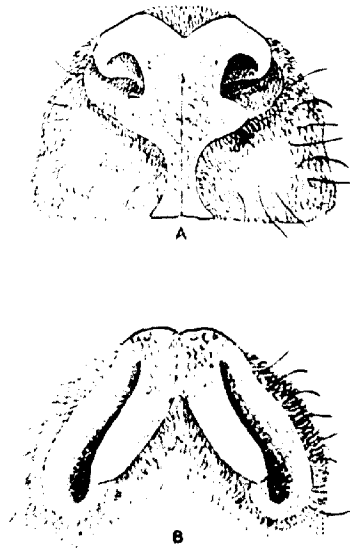
*Preorbital gland*.—Although I was unable in 1910 to discover a trace of this gland on the dried head-skin of *K. defassa*, I suggested the probability of the existence of a gland resembling that of *Adenota kob*. This suggestion, however, very clearly furnished no justification for Mr. Lydekker stating, on my authority, that rudimentary face-glands are present in the genus (Cat. Ung. Mamm. pp. 199 & 225, 1914). Fresh material proved my guess to be erroneous. *Kobus* resembles *Eleotragus* and *Redunca* in having no preorbital glands, as Owen long ago stated.

The *rhinarium* (fig. 2, A, B) was described by Mr. Lydekker as "normal." By this epithet he clearly meant unlike that of *Pelea* and *Eleotragus*. But, as a matter of fact, there are certain features about the *rhinarium* of *Kobus* which, according to my conception, are distinctly abnormal in the sense that, within the limits of the Reduncinæ, they are peculiar to the genera *Kobus* and *Adenota*, the *rhinarium* which most nearly approaches the normal in the Reduncinæ being found in *Redunca*. In *Kobus* the anterior surface of the *rhinarium* is bilobate, owing to the presence of a wide median depression up which the median groove of the philtrum extends as high as the summit of the anterior portion of the nares. There is also a wide area of naked skin passing beneath the nostrils to their posterior extremity laterally. Finally, on the dorsal side the hair of the summit of the muzzle encroaches as an angular field to a point nearly on a level with the anterior extremities of the nostrils, and on each side of this field the upper rim of the nostrils is elevated. The encroachment of this hair gives a biconvex

aspect to the upper edge of the rhinarium from the front aspect, the corresponding edge in *Redunca* being evenly convex from side to side. A rhinarium of this structure is found only in *Kobus* and *Adenota* within the limits of the Reduncinæ.

*Inguinal glands* are absent, as Owen stated, and there is no trace of *pedal glands*.

Fig. 2.



A. Rhinarium of *Kobus defassa* from the front.  $\times 1$ .  
B. The same from above.

The extremity of the *penis* (fig. 1, A) is much more bulbous than in *Redunca*, with a downbent rounded apex, and the urethral canal is of unusual length, recalling that of *Ovis* in the extent to which it overlaps the end of the penis. The figures of the penis of this genus published by Lounberg (*Nova Acta R. Soc. Upsal.* (3) xx. pl. ii. fig. 4, 1904) and by Gerhardt (*Verh. Deutsch. Zool. Ges.* xvi. p. 153, 1906) represent the urethral prolongation as curling up on the left side of the termination of the glans and

closely applied to it. It is also much shorter than in the specimen I examined.

By the characters described in this paper the genera of Reduncinae may be distinguished as follows:—

1. *a.* Rhinarium swollen above and extending back far beyond posterior angle of nostrils. *Pelea, Eleotragus.*  
*a'.* Rhinarium otherwise.  
*b.* Rhinarium not deeply and widely grooved in front, extending as a narrow strip below nostrils laterally: its posterior border nearly straight between the nostrils. *Redunca.*  
*b'.* Rhinarium deeply grooved in front, a wide naked strip below nostrils laterally: its posterior border acutely angular between the nostrils. *Adenota, Kobus.*
2. *a.* Preorbital gland absent. *Pelea, Eleotragus, Redunca, Kobus.*  
*a'.* Preorbital gland a thickened area of skin. *Adenota.*
3. *a.* Inguinal glands absent. *Pelea, Kobus.*  
*a'.* Inguinal glands present.  
*b.* Two pairs of inguinal glands. *Redunca.*  
*b'.* One pair of inguinal glands.  
*c.* Anterior pair of inguinal glands of *Redunca* retained as long anteriorly directed pouches. *Eleotragus.*  
*c'.* Posterior pair of inguinal glands of *Redunca* retained as short inwardly directed pouches. *Adenota.*
4. *a.* Pedal glands retained as flask-shaped sacs with short duct and small orifice. *Pelea.*  
*a'.* Pedal glands aborted. *Eleotragus, Redunca, Adenota, Kobus.*
5. *a.* Penis with urethral tube short, slightly surpassing attenuated end of glans. *Eleotragus, Redunca.*  
*a'.* Penis with urethral tube very long, far surpassing bulbous end of glans. *Kobus.*

Subfamily *EPYCERINÆ* \*.

Genus *EPYCEROS*, Sund.

*Epyceros melampus*, Licht. (p. 918).

The feet of a specimen of this species from British East Africa, brought home for me by Mr. F. C. Selous, enables

\* I instituted this subfamily under this name in 1910, but Lydekker, while adopting the group in 1914 (Cat. Ung. Mamm. iii. p. 4), emended the title to *Epycerotinae*, but quite unwarrantably, *Epycerinae* being, I believe, correctly formed and having the advantage of brevity.



me to confirm my description of the metatarsal glands and to substantiate the correctness of my supposition as to the structure of the fore feet, published in 1910. The fore feet are exactly like the hind feet, except for the absence of the metacarpal glands. Pedal glands are absent. A piece of the skin of the inguinal region of the same specimen showed two pairs of mammæ, but no trace of inguinal glands, thus agreeing with the dried skins in the British Museum. Hence it may be concluded that Owen's statement that inguinal glands are present in the genus is erroneous; and since he affirmed at the same time the existence of large preorbital glands, which, according to universal testimony, are absent, it seems obvious that the specimen he examined did not belong to the genus *Xyloceros* at all, but was probably some large form of *Gazella*.

XXXIV.—*Diagnoses of new Bats of the Families Rhinophoridae and Megadermatidae.* By KNUD ANDERSEN.

[At the request of Dr. Knud Andersen, who expects to be absent from his scientific work for some time, the following diagnoses are published, mostly in the form of extracts from the synopses of species prepared by him for the second volume of the 'Catalogue of Chiroptera.' \*]

By this method the exact relationship of the species to their nearest allies is readily seen, together with the characters distinguishing them.

The "groups" in which the species of *Rhinolophus* are placed are those recognized (though under different names) in Dr. Andersen's "List of the Species and Subspecies of the Genus *Rhinolophus*"\*, 1905.—(O. T.)

Genus RHINOLOPHUS.

*Rh. megaphyllus* group. (Called *simplex* group in the 'Annals' paper, 1905.)

a'. Connecting process higher posteriorly than anteriorly (at junction with sella).

a'. Ears longer, 10.5-21 mm. (inner margin).

General size larger; forearm 40-49 mm.

a'. Nose-leaves larger: breadth of sella at base 2.5-3 mm., of horseshoe 9-10.5.

\* Ann. & Mag. Nat. Hist. (7) xvi. p. 648 (1905).

- Constriction at middle of sella always distinct.
- b*<sup>1</sup>. Nose-leaves smaller; breadth of sella at base 2-2.3 mm., of horseshoe 7.7-9. Constriction of sella often obsolescent.
- c*<sup>1</sup>. Lancet cuneate or subcuneate.
- d*<sup>1</sup>. Lancet hastate or subhastate (constriction of sella obsolescent or absent).
- e*<sup>1</sup>. Nasal swellings 5.2-5.5 mm.; *c-m*<sup>1</sup> 6.7-7.2 ..... *borneensis*
- f*<sup>1</sup>. Nasal swellings 4.9-5.2 mm.; *c-m*<sup>1</sup> 6.2-6.7. Lancet peculiarly shortened (probably nearest hastate), looking as if broader at base than long. Forearm 40-40.5 mm. (S. Java.) ..... *javanicus*, sp. n.
- g*<sup>1</sup>. Ears shorter, 15-16.5 mm. on inner margin. (General size smaller; forearm 37-39 mm.)
- c*<sup>1</sup>. Connecting process as usual. Nasal swellings 4.6-4.8 mm.; *c-m*<sup>1</sup> 6.3-6.5. Forearm 38-39. (Madura.) ..... *madurensis*, sp. n.
- d*<sup>1</sup>. Connecting process rather more pronounced than usual. Nasal swellings 4.3 mm.; *c-m*<sup>1</sup> 5.9-6.3. (Luzon.) ..... *virgo*.
- e*<sup>1</sup>. Connecting process broadly rounded off, as low posteriorly as anteriorly (at junction with sella). Sella distinctly expanded at middle, narrower at base than across expansions, constriction (at or above middle) very distinct.
- c*<sup>1</sup>. Forearm 46 mm.; tibia 20. Sella broader. (Bandon, Lower Siam.) ..... *robinsoni*, sp. n.
- d*<sup>1</sup>. Forearm 40-44 mm.; tibia 16-17. Sella narrower. (Pulo Tioman; P. Pemangil.) ..... *klossi*, sp. n.

*Types:—*

- javanicus*. Female. B.M. no. 9. 1. 5. 174. Original number 1655. Collected 18th March, 1908, by G. C. Shortridge at Pangandaran, Dirk de Fries Bay, S. Java. Presented by W. E. Balston.
- madurensis*. Female. B.M. no. 10. 4. 7. 9. Original number 2164. Collected 4th November, 1909, by G. C. Shortridge at Soemenop, E. Madura. Presented by Oldfield Thomas.
- robinsoni*. Female. B.M. no. 18. 8. 2. 1. Original number 527/13. From Kao Nawng, Bandon, Lower Siam, 13th June, 1913. Presented by the Federated Malay States Museum.
- klossi*. Female. B.M. no. 18. 8. 2. 2. From Pulo Pemangil, June 1915. Presented by the Federated Malay States Museum.

\* *c-m*<sup>1</sup> = front of canine to back of *m*<sup>1</sup>.

*Rh. pusillus* group. (Called *lepidus* group in 1905.)

- a. Connecting process like an erect (nearly equilateral) triangle, its front margin practically straight (non-concave).
- a'. Smaller; forearm 33.5-43 mm. .... (*pusillus* subgroup.)
- a". Skull and teeth larger; skull to front of canine 16.5-18.7 mm.; cond.-can.\* 14.4-16.9; mandible 11-13.2; c-m<sup>2</sup> 6.2-7.5. .... (*lepidus* series.)
- a'. Base of fur of back paler, contrasting with the darker tips .... *lepidus*.
- c'. Skull and teeth averaging larger; total length to front of canine 16.8-18.7 mm.; cond.-can. 15-16.9; c-m<sup>1</sup> 6.5-7.5. Forearm 38-42.5. (Upper Burma.) .... *l. shortridgei*, subsp. n.
- b'. Fur of back uniform from base to tip. .... *refulgens*.
- f'. Sella subacute, its tip forming an equilateral triangle in front view. (Sumatra.) .... *r. cuneatus*, subsp. n.
- b'. Skull and teeth smaller; skull to front of canine 15.3-16.7 mm.; cond.-can. 13.5-14.8; mandible 9.8-11; c-m<sup>2</sup> 5.5-6.4. .... (*pusillus* series.)
- (Fur of back pale at base. Sella conspicuously constricted at middle, markedly narrower at tip than at base.)
- a'. Smaller, with relatively shorter tibia and smaller foot. Skull 15.3-16 mm.; cond. can. 13.5-14.2; forearm 35.5-39.7; tibia 14-16; foot (c. u.) 7-8. .... *blythi*, sp. n.
- a'. Canines, p<sup>1</sup> and p<sub>1</sub> unmodified; p<sub>1</sub> sometimes external, but generally half or wholly in row. Forearm 35.5-39.7 mm. .... *b. blythi*.
- a'. Fur conspicuously pale above and below. (Kumaon.) .... subsp. n.
- b'. Fur conspicuously darker above and below. (Darjiling to China.) .... *b. szechuanus*.
- b'. Canines much heavier than in a'; p<sup>1</sup> and p<sub>1</sub> conspicuously reduced in size; p<sub>1</sub> generally external. General size as in a'. .... *perditus*, sp. n.
- c'. Teeth markedly larger; c-m<sup>2</sup> 6.4 mm.; c-m<sub>1</sub> 6.7. (S. Liu-Kiu; Ishigaki.) .... *pauculus*.
- d'. Teeth not larger than usual; c-m<sup>2</sup> 5.5-5.7 mm.; c-m<sub>1</sub> 5.8-6.1. (Middle Liu-Kiu; Okinawa.) .... *cornutus*.
- b'. Larger, with relatively longer tibia and larger foot. Tibia 16.5-17.5 mm. (Japan.) .... (*acuminatus* subgroup.)
- k'. Larger; forearm 44.5-51.5 mm. .... (*garzeus* subgroup.)
- b. Connecting process like an erect anteriorly curved horn, its front margin conspicuously concave

\* cond. can. = length of skull from condyle to front of canine.

- a'. Smaller. Skull, length to canine 15-15.2 mm. .... *garoensis*.  
 b'. Larger. Skull, length to canine 16.4-18 mm., c n° 6.3-7; forearm 39-40.  
 c'. Smaller. Skull, length to canine 16.4-17 mm., condyle to canine 14.6-15.3, mandible 11.2-11.7, c m° 6.3-6.7; forearm 39-39.5. (North Central Island, Andamans.) .... *famulus*, sp. n.  
 d'. Larger. Skull, length to canine 18 mm. (Port Blair, S. Andamans.) .... *regnatus*.

*Types:—*

- lepidus shortridgei*. Male. B.M. no. 18. 8. 3. 1. Original number 4015. Collected 12th October, 1913, at Pagan, R. Irrawaddy, Burma, by G. C. Shortridge. Presented by the Bombay Natural History Society. A large series examined. Also one from Kindat, Chindwin.  
*refulgens cuneatus*. Male. B.M. no. 7. 1. 9. 3. From Sukaranda, Deli, Sumatra. Collected by Dr. H. Dohrn. Presented by the Museo Civico, Genoa. Paratype in Genoa Museum.  
*blythi*. Female. B.M. no. 18. 8. 3. 2. Original number 3879. Collected 23rd October, 1913, at Almora, Kumaon, 5500', by C. M. Crump. Presented by the Bombay Natural History Society.  
*blythi szechuanus*. Female. B.M. no. 13. 1. 26. 2. Collected at Chung-King, Sze-chwan, 27th Sept., 1912, and presented by Mr. W. R. Brown. Other specimens from Daijiling, Taihò, Burma, Yunnan, other localities in Sze-chwan, and Foochow.  
*perditus*. Female. B.M. no. 5. 11. 3. 15. From Ishigaki, southern Liu-Kiu. Purchased of Alan Owston.  
*famulus*. Female. B.M. no. 9. 4. 4. 8. From North Central Island, Andamans. Presented by the Indian Museum, Calcutta.

*Rh. hipposideros* group. (*midas* group, 1905.)

*Rh. hipposideros*—synopsis of subspecies:—

- a. Infraorbital bridge linear (very rarely somewhat broadened) .... *minimum, hipposideros, & minutus*.  
 b. Infraorbital bridge broadened.  
 a'. Infraorbital bridge as a rule somewhat, though not often much broadened. Size about as in *minimum*. Forearm of type 37.5 mm. Skull, length to front of canine 15.6, condyle to canine 13.8, c m° 5.6. (Corsica and Sardinia.) .... *majori*, subsp. n.

- e*. Infraorbital bridge nearly always much broadened.  
*a*<sup>2</sup>. *p*<sub>3</sub> nearly always present. Size as *hipposideros*. (Gilgit to Cyprus.) . . . . . *midas*.  
*b*<sup>2</sup>. *p*<sub>3</sub> nearly always absent. Size as *minimus*. Forearm of type 37 mm. Skull, length to front of canine 15.3, condyle to canine 13.6, *c-m*<sup>3</sup> 5.5. (Morocco.) . . . *escalerae*, subsp. n.

*Types:—*

*majori*. Male. B.M. no. 6. 4. 14. 3. Patrimonio, N. Corsica. Collected and presented by Dr. C. I. Forsyth Major.

*escalerae*. Female. B.M. no. 10. 11. 21. 2. Ha-ha, Mogador, Morocco. Collected by M. de la Escalera. Presented by Oldfield Thomas.

*Rh. luctus group. (philippinensis group, 1905.)*

- c*. Smaller; skull to front of canine less than 25 mm.; forearm 42.5-54.  
*c*<sup>1</sup>. Ears shorter; from base of inner margin 20-23 mm. Nose-leaves smaller; breadth of horseshoe 9.5-10. Fur dark. Skull smaller and narrower, to front of canine 20.5-22; mandible 13.8-15; across *m*<sup>1</sup> 7.2-7.8. Forearm 42.5-50.  
*a*<sup>1</sup>. Considerably smaller. (Borneo.) . . . . . *sedulus*.  
*b*<sup>1</sup>. Considerably larger; canine to *m*<sup>1</sup> 8.4-8.5 mm.; forearm 48.5-50. Infraorbital canal longer. (Malay Peninsula.) . . . . . *rdax*, sp. n.  
*d*. Ears larger; &c. . . . . *trifoliatus, niaensis, [colivarius]*.  
*d*. Larger; skull to front of canine more than 25 mm.; forearm 57-75.5.  
*e*. Ear shorter, 28-30.5 mm.; forearm 57-63. . . . . *beddomei*.  
*e*<sup>1</sup>. Averaging smaller; *c-m*<sup>1</sup> 9.7 mm.; forearm 57. (Ceylon.) . . . . . *b. sobrinus*, subsp. n.  
*f*<sup>1</sup>. Averaging larger; *c-m*<sup>1</sup> 10.2-10.8 mm.; forearm 59.5-63. (Indian Peninsula.) . . . . . *b. beddomei*.  
*f*<sup>1</sup>. Ear longer, 34-39 mm.; forearm 63.5-75.5.  
*g*<sup>1</sup>. Ear smaller; &c. . . . . *morio*.  
*c*<sup>1</sup>. Ears averaging smaller. Colour generally darker. (Malay Peninsula.) . . . . . *m. morio*.  
*d*<sup>1</sup>. Ears averaging larger. Colour generally lighter. (Borneo.) . . . . . *m. fortidus*, subsp. n.

*Types:—*

*rdax*. Female. B.M. no. 7. 4. 18. 1. Singapore. Collected and presented by H. N. Ridley.

*beddomei sobrinus*. Female. B.M. no. 18. 8. 3. 3. Original number 1137. Collected at Kala Oya, N.C.P., Ceylon,

by Major E. W. Mayor. Presented by the Bombay Natural History Society.  
*morio fatidus*. B.M. no. 89. 1. 8. 4. Baram, E. Sarawak.  
 Collected by Dr. Charles Hose.

*euryotis* group. (*arcuatus* group, 1905.)

- |  |                           |
|--|---------------------------|
| a. No special modification of hairing of posterior leaf  | <i>euryotis</i> subgroup. |
| b. Median (intercellular) portion of posterior leaf clothed with long, semi-rigid, densely set hairs   | <i>creaghi</i> subgroup.  |
| a'. Posterior connecting process unmodified; hairs of posterior leaf bushy, not specially arranged   | <i>canuti</i> .           |
| b'. Posterior connecting process practically absent; hair of posterior leaf arranged in a conical tuft pointing towards posterior face of sella. |                           |
| a". $P_3$ and $p_3$ not smaller than usual; ears longer; forearm 48.5 mm. (Madura).  | <i>pilosus</i> , sp. n.   |
| b". $P_3$ rudimentary or wanting, $p_3$ reduced; ears smaller  | <i>creaghi</i> .          |

Type of *H. pilosus*.—Male. B.M. no. 10. 4. 7. 5. Original number 2162. Collected at Marengan, Soemenep, E. Madura, Java, 4th November, 1909, by G. C. Sherridge. Presented by Oldfield Thomas.

*Arctia tridens diluta*, subsp. n.

Like *A. tridens tridens*, but averaging larger, and colour of fur conspicuously paler.

Forearm 52.2 mm.

Skull; length to foot of canine 18.7; cond.-can. 16.6;  $c-m^2$  7;  $c-m_2$  7.7.

*Hab.* (of type). El Golea, Algerian Sahara. Other specimens from Biskra.

*Type*. Female. B.M. no. 12. 11. 14. 2. Original number 42. Collected 16th May, 1912, by Dr. E. Hartert. Presented by Lord Rothschild.

Genus HIPPOSIDEROS.

*H. bicolor* group.

- a.  $P_1$  comparatively large, from  $\frac{1}{2}$  to practically the full antero-posterior length of  $p_1$ , its cusp always reaching above middle of cusp of  $p_1$ , internasal septum thick or even pear-shaped (thicker posteriorly).

- a*. Smaller forms. Skull, cond.-can. 13-15.1 mm., *c-m*<sup>3</sup> 5-6; forearm 34-42.5.  
*a*<sup>2</sup>. Smallest. Skull, cond.-can. 13-13.8 mm., *c-m*<sup>3</sup> 5-5.5; forearm 34-40.2.  
*a*<sup>3</sup>. Forearm 34-36.7 mm. (India, Burma, Borneo.) ..... *cinereus*,  
*anticola*.  
*b*<sup>1</sup>. Forearm 37-40.2 mm. (Philippines.)  
*b*<sup>2</sup>. Larger. Skull, cond.-can. 13.8-15.1 mm., *c-m*<sup>3</sup> 5.5-6; forearm 37-42.5.  
*c*<sup>1</sup>. Skull somewhat narrower in front; across canines 3.5-3.7 mm.  
*a*<sup>4</sup>. Decidedly paler. Forearm 37-42 mm. (Sumatra, Java.) ..... *bicolor*.  
*b*<sup>3</sup>. Decidedly darker.  
*a*<sup>5</sup>. Skull averaging smaller, cond.-can. 13.6-14.6 mm. Forearm 38-41.8. (Ceram, New Guinea, Port Albany.) ..... *albanensis*.  
*b*<sup>4</sup>. Skull averaging longer, cond.-can. 15.1 mm. Forearm 40-42. (Key Is.) ..... *albanensis* subsp. n.  
*d*<sup>1</sup>. Skull somewhat broader in front; across canines 4-4.1 mm. Forearm 38-42.5. (Nicobars.) ..... *albanensis* *seena*,  
*nicobarula*.  
*b*. Larger forms. Skull, cond. can. 15-16.7 mm., *c-m*<sup>3</sup> 6-6.8. Forearm 38-5-46.2.  
*c*<sup>1</sup>. Nose-leaves broader than usual. Horseshoe 5.8 mm., sella 5.2. Forearm 40-5. (Coorg) ..... *ponona*, sp. n.  
*d*<sup>1</sup>. Nose-leaves not broader than usual. Horseshoe 4.5-5.5 mm., sella 3.7-4.8. . . . . *gentilis*, sp. n.  
*c*<sup>1</sup>. Smaller. Skull, cond. can. 15-15.6 mm., *c-m*<sup>3</sup> 6-6.2; forearm 38-5-41.5. (Masuri, Burma, Pegu.) ..... *g. gentilis*.  
*f*<sup>1</sup>. Medium. Cond. can. 15.7-16.3 mm., *c-m*<sup>3</sup> 6.2-6.7; forearm 40-46.2.  
*c*<sup>1</sup>. Smaller; forearm 40-43 mm. (Siam, Fokien.) ..... *g. sinensis*, subsp. n.  
*d*<sup>1</sup>. Larger; forearm 42-46.2 mm. (Malay Peninsula) ..... *g. atra*, subsp. n.  
*g*<sup>1</sup>. Largest. Cond. can. 16-16.7 mm., *c-m*<sup>3</sup> 6.5-6.8; forearm 44.8-46. (Nias, Engano.) ..... *g. major*, subsp. n.  
*b*. *P*. small, from a little less than  $\frac{1}{4}$  to about  $\frac{1}{2}$  the length (ant. post.) of *p*<sub>1</sub>, its cusp below, or at most at the middle of the cusp of *p*<sub>1</sub>; internasal septum very thin, narrowing into a sharp edge posteriorly.  
*c*<sup>1</sup>. Forearm less than 44 mm.; *c-m*<sup>3</sup> below 6. Nose-leaves smaller.  
*c*<sup>1</sup>. Smaller. Forearm 36-37.3 mm. Ears shorter. (Ceylon and S. India) ..... *atratus*.  
*d*<sup>1</sup>. Larger. Forearm 39.5-43 mm. Ears larger. (Indian Peninsula) ..... *fulvus*.  
*A*<sup>1</sup>. Colour of fur averaging darker. (Indian Peninsula as far north as Nank.) ..... *f. fulvus*.

- ♂. Colour of fur paler. (Kathiawar, Cutch, Sind, Rajputana.) ..... *f. pallidus*, subsp. n.  
 ♂. Forearm 46 mm.; *c-m* 6·8. Nose-leaves larger, 6×8 mm. (Selangor.) ..... *nequam*, sp. n.

*Types:—*

- albanensis sævus*. Female. B.M. no. 99. 12. 4. 12. From Key Is. Purchased of Rolfe.  
*pomona*. Male. B.M. no. 18. 8. 3. 4. Original number 2605. Collected by G. C. Shortridge at Haleri, N. Coorg, 15th February, 1913. Presented by the Bombay Natural History Society.  
*gentilis*. Male. B.M. no. 93. 11. 15. 2. From Thayetmyo, Burma. Presented by Lieut. E. Y. Watson.  
*g. sinensis*. B.M. no. 92. 2. 1. 3. From Foo-chow, Fo-kien. Presented by J. de La Touche, Esq.  
*g. atrox*. Female. B.M. no. 1. 3. 9. 4. From Semangko Gap, Selangor, 2800'. Presented by A. L. Butler, Esq.  
*g. major*. Male. B.M. no. 94. 1. 7. 6. From Bua-Bua, Engano Island. Collected by Dr. E. Molighani. Presented by the Museo Civico, Genoa.  
*fulvus pallidus*. Male. B.M. no. 18. 8. 3. 5. Original number 1636. Collected at Junagadh, Kathiawar, 21st Sept., 1912, by C. A. Clump. Presented by the Bombay Natural History Society.  
*nequam*. Male. B.M. no. 85. 8. 1. 369. From Klang, Selangor. Collected by W. Davison. Presented by A. O. Humph.

*H. diadema* group.

- A. Skull in front of sagittal crest concave; meso-pterygoid space broader, palatine angle broadly rounded off; lateral vertical ridges of posterior leaf obscure ..... *diadema* sub-section.  
 a. Smaller ..... *demissus*.  
 b. Larger ..... *diadema*.  
 a'. Averaging smaller; *c-m* 11·3-13·6 mm. Three supplementary leaves. *fus.*  
 a". Forearm 73-82·5 mm. .... *d. oceanites*, *d. pulch.*  
 b". Forearm 76-87·5 mm.  
 c. Ears not larger than usual: length 27-28·5 mm., breadth 25-28·5.  
 a'. Colour more brownish above and beneath. (Key Is.) ..... *d. castor*, subsp. n.  
 b'. Colour powdered with greyish above and still greyer below ..... *d. griseus*.  
 d". Ears larger: length about 30 mm., breadth 28·5-29·8.  
 e". Skull and dentition weaker; *c-m* about 12·3 mm. (Celebes.) ..... *d. speculator*, subsp. n.



- d*<sup>2</sup>. Skull and dentition heavier: *c-m*<sup>3</sup> 13.2-13.6 mm. (Gilolo.) ..... *d. euotis*.
- B. Skull in front of sagittal crest convex or flattened; mesopterygoid space narrower; palatine angle acute or subacute; upper border of posterior leaf trilobate; lateral vertical ridges strong ..... *lankadiva* subsection.
- c*. Larger. (Ceylon.) ..... *lankadiva*.
- d*. Smaller. (Indian Peninsula.) ..... *indus*, sp. n.
- e*<sup>1</sup>. Skull larger, length to front of canine 29.8-32.2 mm.; *e-m*<sup>1</sup> 12.5-13.5. General colour dark brown or grey-brown.
- e*<sup>2</sup>. External dimensions averaging smaller: forearm 77-84.5 mm.
- e*<sup>3</sup>. General colour above dark brown, base of hairs not white. (Kanara.) ..... *indus indus*.
- f*<sup>1</sup>. General colour above grey-brown, base of hairs white. (E. Mysore.) ..... *i. mixtus*, subsp. n.
- d*<sup>3</sup>. External dimensions larger: forearm 82-88 mm. Colour as *f*<sup>1</sup>. (Hoshangabad, Saugor.) ..... *i. unius*, subsp. n.
- f*<sup>2</sup>. Skull smaller, to front of canine 28.5-28.8 mm.; *e-m*<sup>1</sup> 11.5-11.1. General colour above slaty, with white bases to hairs. (Bellary.) ..... *schistaceus*, sp. n.

*Types:—*

- H. diadema castor*. Male. B.M. no. 10. 3. 1. 27. Original number 850. Collected July 1909 at Ara, Key Island, by W. Stalker. New Guinea Expedition.
- d. speculator*. Female. B.M. no. 97. 1. 3. 20. From Kalao, S. Celebes. Collected by A. Everett.
- indus*. Female. B.M. no. 12. 11. 28. 20. Original number 1169. Collected at Gersoppa, Kanara, 19th May, 1912, by G. C. Shortridge. Presented by the Bombay Natural History Society.
- i. mixtus*. Male. B.M. no. 13. 4. 11. 19. Original number 1747. Collected 18th September, 1912, at Kolar, E. Mysore, by G. C. Shortridge. Presented by the Bombay Natural History Society.
- i. unius*. Female. B.M. no. 12. 11. 29. 20. Original number 1201. Collected 25th April, 1912, at Mumbai, Saugor, C.P., 1909, by C. A. Crump. Presented by the Bombay Natural History Society.
- schistaceus*. Male. B.M. no. 13. 4. 10. 3. Original number 1462. Collected 26th July, 1912, at Vijayanagar, Bellary, by G. C. Shortridge. Presented by the Bombay Natural History Society.

*H. speoris* group.

The subspecies of *speoris* :—

- a. Skull, length to foot of canines 19-20.3 mm. (average of 108 specimens 19.7 mm.); forearm 49.8-54 (average 52). (Ceylon, Kanam, Bombay, Khandeish, Mysore.) ..... *s. speoris*.  
 b. Skull, length 18-19.8 mm. (average of 34 specimens 18.8 mm.); forearm 45.8-51.5 (average 49.4). (Bellary.) ..... *s. pulchellus*, subsp. n.

Type of *H. s. pulchellus* :—Female. B.M. no. 13. 4. 10. 13. Original number 1473. Collected 27th July, 1912, at Vijayanagar, Bellary, by G. C. Shortridge. Presented by the Bombay Natural History Society.

*H. calcaratus* group.

*H. cupidus*, sp. n.

Nearly allied to *H. calcaratus*, but with teeth considerably smaller, canine to  $m^3$  7.3-7.5 mm. as compared with 8.2-8.3 in *calcaratus*. Forearm in the immature type 46.2; in an adult from Jobi Island 49.2.

Type. Immature male. B.M. no. 97. 12. 6. 4. From Eaga, British New Guinea. Collected by A. S. Anthony. Presented by Lord Rothschild.

Genus MEGADERMA.

Subspecies of *M. spasma* :—

- a. Tibia averaging shorter, 27-28 mm. (Celebes, Philippines.) ..... *M. s. spasma*.  
 b. Tibia averaging longer, 28.5-33.5 mm.  
     a'. Length of skull 24.1-26.3 mm.; lower jaw 16.9-18;  $c m^3$  9.5-10. Forearm 54-58.5. (Java, Kangean, Sumatra, Borneo.) ..... *s. trifidum*.  
     b. As *trifidum*, but averaging perceptibly larger. Forearm 55-61.5 mm. (Malay Peninsula, S. Tenasserim.) ..... *s. medium*, subsp. n.  
     c. Maximum of size in the species; lower jaw 17.8-19 mm.;  $c m^3$  10-10.8. Forearm 62-63. (Lower Chindwin.) ..... *s. major*, subsp. n.  
     d. As *trifidum*, but more delicately built; lower jaw 16.6-17.3 mm.; zygomatic breadth of skull 13.7-14.3 mm. (against 14.3-15.5). Forearm 53.5-60.5. (Siam, Cambaja.) ..... *s. minor*, subsp. n.

- e.* Much like *trifolium*, but with narrower skull; zygomatic breadth 13·8–14·8 mm. Forearm 54–58·5. (Indian Peninsula.) . . . . . *s. horsfieldi*.  
*f.* As *s. horsfieldi*, but averaging smaller externally. Forearm 52–50·5 mm. . . . . *s. ceylonense*, subsp. n.

*Types:—*

- M. s. medium.* Female. B.M. no. 96. 4. 15. 1. From Singapore. Collected and presented by H. N. Ridley.  
*s. mojus.* Female. B.M. no. 18. 8. 3. 6. Original number 5354. Collected at Kin, Lower Chinlwin, by G. C. Shortridge. Presented by the Bombay Natural History Society.  
*s. minus.* B.M. no. 78. 6. 17. 42. From Camboja. Presented by M. Pierre.  
*s. ceylonense.* Male. B.M. no. 18. 8. 3. 7. Original number 1317. Collected at Trincomalee by Major E. W. Mayor. Presented by the Bombay Natural History Society.

XXXV.—*Descriptions and Records of Bees.*—LXXX.

By T. D. A. COCKERELL, University of Colorado

*Xylocopa collaris*, Lepeletier.♂. Sandakan, Borneo (*Baker*).

This is the form which Lepeletier described from Java as *X. dejeanii*. His *collaris* was based on females, doubtless of more than one race, but it may be restricted to the Malayan form, with Sumatra as the type locality.

*Xylocopa collaris penangensis*, subsp. n.

♂. (Type).—Similar to the Philippine *X. fuliginata*. Pérez, in having the light hair covering first and basal two-fifths of second segments of the abdomen, the lower margin straight. Otherwise it is like *X. collaris*, with pale hair on thorax above, except a narrow band along anterior edge of scutellum. The metathorax has black hair. In the colour of the hair on legs and apex of abdomen it resembles *X. collaris* var. *bryanti*, Ckll., from Java, but the wings are not darker than in typical *collaris*. The thorax dorsally is very faintly greenish. The pleura has pale hair on upper part and black on the lower. The insect is a little smaller than typical *collaris*.

♀.—Differs from *X. fuliginata* in being smaller (anterior wing 16·5 mm.), with the wings darker and brilliantly violet, and the thorax anteriorly with a band of white hair. The white thoracic band is narrower and less conspicuous than in *collaris*, and sends only a small and feeble extension to the pleura.

Island of Penang (*Baker*).

*Mesotrichia bombiformis* (Smith).

Mauila, Philippine Is., Jan. 1, 1918 (*McGregor*).

The wings are much greener apically than in one from Los Baños.

*Mesotrichia confusa viridissima*, subsp. n.

♀. (Type).—Larger, anterior wing 23 mm.; anterior and posterior wings brilliant bluish green.

♂.—Yellow hair of thorax above brighter; second sub-marginal cell a little longer.

Island of Penang (*Baker*).

Pérez cites various localities for *confusa*; Singapore may be designated as the type locality. I have both sexes from Singapore, collected by Baker. The shorter wings of the females are violaceous, apically obscure green. Exactly the same thing, determined as *confusa* by Maill, was received from the Berlin Museum, labelled "*Sikhim (Dougham)*." It is unfortunate that some assistant at the Berlin Museum put "*Sikhim*" labels on numerous bees which never came from that region.

A specimen of *M. confusa* from Trong, Siam (*Abbot*), is intermediate between the type and *viridissima*, having the long wings of the latter, but with some violaceous colour, though they are mainly green. It is certainly nearest to *viridissima*.

*Trigona geissleri*, Friese.

I have a male from Sintang, North Borneo; and a couple of workers collected at Singapore by Baker appear to belong to the same species. It is a black insect, with broad abdomen; legs black, but trochanters red or reddish; scape clear ferruginous; front and mesothorax polished. It has some resemblance to *T. canifrons* and *T. leviceps*, but is clearly distinct. The Bornean male has the flagellum black, but in the Singapore workers it is ferruginous, more or less dusky above. The Singapore insect should perhaps

be separated, but we should first see Bornean workers. I have not seen any publication of *T. geissleri*, but it may have appeared in Germany since the mails from that country to America were discontinued.

*Trigona pallidicincta*, sp. n.

♂.—Length nearly 9 mm.

Head and thorax black, the clypeus, supraclypeal area, labrum, mandibles, upper border of prothorax, tubercles, and tegulae pale ferruginous; antennae black, scape red at extreme base; sides of face covered with appressed greyish-white hair; vertex with long dark fuscous hair; thorax with short pale hair at sides, but dorsally it is mainly fuscous; scutellum with a pale (tegumentary) patch posteriorly, and middle of metathorax suffusedly reddened; front not polished, except a triangular area in front of ocelli; mesothorax shining, with three impressed lines, the lateral ones deep. Wings hyaline, faintly reddish, stigma ferruginous, nervures fuscous. Legs very pale reddish basally, otherwise dark brown. Abdomen brown, darker apically; base of first segment, and its broad apical margin, pale testaceous, the light colour sharply defined; base of third segment broadly pallid.

Singapore (*Baker*).

Resembles *T. eastonae*, Bingham, but the wings are quite differently coloured. There is a rather strong superficial resemblance to the African *T. conaulti*, Fr.

*Trigona melanotricha*, sp. n.

Worker.—Length about 7.5 mm.

Black, very robust, with rather long and coarse black hair; head broad; clypeus and mandibles obscure reddish; front of face dark, the sides with thin appressed brown hair; front polished and shining; cheeks with thin brown pile; scape in front and flagellum beneath dull red, third antennal joint entirely bright ferruginous; mesothorax and scutellum shining; tegulae dark reddish. Wings hyaline, heavily orange-tinted, nervures and stigma clear ferruginous; transverse cubital nervures obsolete. Legs black, with coarse black hair; hind tibia very broad, fringed with very long black hair. Abdomen short and broad, shining, obscure reddish basally.

Sandakan, Borneo (*Baker*, 9222).

Related to *T. erythraetona*, Cam., but quite distinct.

*Trigona rufibasalis*, sp. n.

*Worker*.—Length a little over 6 mm.

Rather slender, but the head broad. Black, with the mandibles dull red at apex, and tarsi red at apex; face with very thin greyish pile; front polished and shining; scape bright ferruginous; flagellum dark, reddish at extreme base, and red beneath at apex; mesothorax shining, without distinct impressed lines; hair of thorax above black but scanty; tegulae picuous. Anterior wings with the basal half orange-ferruginous, the apical field clear; hind wings dusky throughout. Hind tibiae not very broad for the genus. Abdomen shining black, venter with bands of black hair.

Sandakan, Borneo (Baker, 9225).

Somewhat related to *T. collina*, Sm., and *T. vidua*, Lep., but the wings are differently coloured, and the head and thorax are shining.

The above species of *Trigona* were received from Prof. C. F. Baker, with others from Sandakan, Borneo, and Singapore. The following key separates and records all the species represented in the series:—

- |  |                                 |
|--|---------------------------------|
| Clear ferruginous. (Sandakan.)   | 1. <i>collina</i> , Gribodo.    |
| At least the thorax or abdomen dark  | 2.                              |
| 1. Mesothorax red, sometimes dark  | 3.                              |
| Mesothorax pure black  | 4.                              |
| 2. Face pale or red up to level of antennae (Sandakan)   | 5. <i>apicalis</i> , Smith.     |
| Only clypeus red. (Sandakan and Singapore, the latter space a little shorter in the Singapore form.) | 6. <i>apicalis</i> , Gribodo.   |
| 3. Tegulae clear testaceous; abdomen brownish (Singapore)  | 7. <i>pubescens</i> , Gribodo.  |
| Tegulae darker   | 8.                              |
| 4. Large species, with reddish clypeus, and wings basally orange-ferruginous. (Sandakan)             | 9. <i>pubescens</i> , Gribodo.  |
| Smaller; or if rather large, clypeus black   | 10.                             |
| 5. Scape black, except at extreme base, larger species   | 11.                             |
| Scape ferruginous; smaller species   | 12.                             |
| 6. Wings dilute fuliginous. (Singapore)  | 13. <i>pubescens</i> , Gribodo. |
| Wings not fuliginous. (Sandakan)   | 14. <i>pubescens</i> , Gribodo. |
| 7. Wings strongly reddened basally, apically hyaline. (Sandakan)                                     | 15. <i>pubescens</i> , Gribodo. |
| Wings greyish hyaline  | 16.                             |
| 8. Larger; abdomen broad. (Singapore)  | 17. <i>pubescens</i> , Gribodo. |
| Smaller; abdomen narrow. (Singapore)   | 18. <i>pubescens</i> , Gribodo. |

*Megachile penangensis*, sp. n.

?—Length about 11 mm.

Face below level of antennae with black hair, front and

vertex with red hair, lower part of cheeks with white hair; thorax above and first abdominal segment with very bright red hair, thorax beneath with thin white hair; second abdominal segment with a narrow fulvous band, but rest of abdomen black and bandless; ventral scopa white, black on last two segments; antennæ black; mandibles quadridentate; legs black, with pale hair, red on inner side of tarsi and of anterior and middle tibiæ; tegulae red. Wings deep fuliginous, hyaline basally.

Island of Penang (*Baker*, 9277).

Very close to *M. schauinslandi*, Alfken, and at first sight appearing identical, but certainly distinct by the much more closely and finely punctured abdomen. Prof. Baker sends me Hawaiian *M. schauinslandi*, determined by Friese as *M. umbripennis*, Smith, and this synonymy seems correct. *M. penangensis* nearly agrees with the description of *umbripennis*, but lacks the white hair-bands at sides of abdomen. Also from Penang comes *Megachile conjuncta*, Sm. (*Baker*, 9273).

*Megachile facetula*, sp. n.

♀.—Length about 11 mm.

Rather slender; black, including antennæ and legs, but tegulae ferruginous; front, vertex, broad oblique bands from prothorax to below wings, and narrow sides of mesothorax, with bright ferruginous hair; lower margin of clypeus bituberculate in middle; mesothorax and scutellum very coarsely and densely rugosopunctate; ventral scopa white, black on last segment. Abdomen dorsally strongly punctured, segments 1-4 with lateral short bands of white hair, fifth with a narrow entire band. Wings basally hyaline, but otherwise dark fuliginous, splendidly iridescent, with purple colours.

Sandakan, Borneo (*Baker*, 9278).

This looks like *M. faceta*, Bingham, and is closely allied, differing by the narrower cheeks (from upper part of eyes to occipital margin much less than diameter of eye), sculpture of thorax not so coarse, and abdomen without metallic colours. Also from Sandakan comes *M. atrata fulvipennis* (Smith).

*Megachile ramera*, sp. n.

♀.—Length about 14 mm.

Robust; black, including antennæ, legs, and tegulae; ventral scopa very bright ferruginous, white at extreme base; face, front, and vertex with black hair, a little white

about bases of antennæ and at each side of upper end of clypeus; cheeks with white hair; mandibles strongly keeled externally, the cutting-edge very long; clypeus broadly emarginate, the emargination crenulate, and with a median denticle; supra-clypeal area flattened, polished and sparsely punctured in middle; clypeus rather closely punctured, with a smooth median line on upper part; thorax at sides, beneath, and metathorax with long white hair, but black hair in middle of mesopleura; mesothorax shining, strongly but not very densely punctured, appearing bare, but with short black hair, the lateral margins with white hair; scutellum with black hair, but a thin band of white between it and mesothorax. Wings dusky, nervures dark fuscous; tibial spurs ferruginous. Legs with mainly pale hair, ferruginous on inner side of the broadened hind basitarsi. Abdomen broad, with beautiful green and purple colours; hind margins of segments with narrow bright ferruginous hair-bands.

Singapore (Baker, 9274).

A beautiful species; closely related to the Australian *M. penetratus*, Sm., but readily known by the red abdominal bands and the wholly black hair of front. Also from Singapore comes a female *M. subricator*, Ckll. (Baker, 9275).

*Megachile subignita*, sp. n.

♀.—Length about 13.5 mm.

Not very robust; black, including antennæ and legs, tegulae red; ventral scopa white at base, pale ferruginous in middle, black on last two segments; lower margin of clypeus gently arched, simple; clypeus densely punctured, with a smooth median line; front and sides of face with ferruginous hair, vertex with thin fuscous hair, lower part of cheeks with white; sides of mesothorax and scutellum, tubercles, upper part of pleura, and metathorax with long bright ferruginous hair; mesothorax and scutellum shining, strongly but not densely punctured, with thin fulvous hair on disc. Wings reddish dusky, nervures ferruginous, the outer ones becoming fuscous. Legs with pale hair; tibial spurs ferruginous; hind basitarsi not very broad, their inner side with red hair. Abdomen finely punctured, with greenish tints; hind margins of segments with narrow pale red hair-bands, sides of first segment heavily tufted with bright ferruginous hair.

Singapore (Baker, 9276).

In Friese's tables runs nearest to *M. penetrata*, Sm., but that is much larger, and otherwise different.



*Paracolletes metallicus* (Smith).

Males. Waipara, New Zealand, Nov. 21 (*Brittin*).

*Haliplus acarius*, Smith.

Males from Kobe, Japan (*Baker*).

*Chelynia elegans* (Cresson).

Estes Park Village, Colorado, June (*Hazel Andrews*).

*Osmia pentstemonis*, Cockerell.

Peaceful Valley, Colorado, at flowers of *Pentstemon*,  
July 5 (*Cockerell*).

*Osmia hendersoni*, Cockerell.

Tolland, Colorado.

#### BIBLIOGRAPHICAL NOTICE.

*Life and Letters of Sir Joseph Dalton Hooker, G.C.M.G., G.C.S.I.*  
*Based on Materials collected and arranged by Lady Hooker.*  
With nine Portraits and Illustrations. By Evelyn Harvey,  
author of 'Life and Letters of T. H. Harvey,' etc. London:  
John Murray, 1918. 2 vols. 8vo. I., pp. xi, 546; II., vii, 539.  
36s. net.

Amongst the methods of writing a biography there are two which are predominant—one the strictly chronological, which leads the reader along as the subject lived, and enables him to trace the influence which moulded the life as they occurred, and the other, which may be termed the episodic method, by describing certain episodes of the life, and treating them fully, disregarding any overlapping of dates. The present work is largely on the second plan, probably wisely chosen, but having the disadvantage of rendering the sequence of dates at times somewhat difficult to follow.

Born in 1817 at Halesworth, Suffolk, of parents and grandparents of Norfolk birth, and having a botanical atmosphere from his early days, the future Sir Joseph Hooker passed his boyhood, University career, and early training in Germany. Four years on H.M.S. 'Erebus' in Arctic service were followed by service on the Geological Survey as botanist, and then came a still more important journey in India, particularly amongst the Himalayas in Sikkim. Here his work was so thorough that, besides his large collection of plants and seeds, the map of Sikkim which he plotted proved of invaluable help to the British military expedition of 1903.

Ten years as assistant to his father, the Director of the Royal Botanic Gardens, Kew, were followed by twenty more as Director, and then by twenty-six of busy scientific labours unshackled by the claims of official administration, until that December day in 1911 when he was laid to rest beside his father in the churchyard on Kew Green, a veteran of 94 years, full of honours, with a splendid record of work.

His published works are proof of the power he possessed of pursuing his purposed path, in spite of absorbing official duties as head of the great national botanic institution, which owes so much to the two Hookers.

Where so much was accomplished it is hard to select for mention, but we may instance the six quarto volumes on the material brought home from the Southern Seas, '*Flora Antarctica*,' '*Flora Novaæ Zelandiæ*,' and '*Flora Tasmanicæ*,' 1844-60. Here we have not merely an enumeration of the plants, but in the '*Flora Tasmanicæ*' we find a luminous exposition of distribution in space and time prefixed to the enumeration. His '*Himalayan Journals*,' 1854, form a fascinating record of his travels and activity in that region. A faculty he possessed in singularly true measure, of collecting facts and putting them into a convincing and lucid form, even on a small scale, and we note how he rapidly seized the important characters of plants and so described them, that his writings are readily utilized.

His masterly survey of Arctic plants (1861) shows how keen he was on questions of distribution, and his account of the plants of the Galapagos Islands (1899), both in the *Linnean Society's* '*Transactions*,' confirm this statement.

With Dr. Thomas Thomson (1847-78) he assisted at '*Flora Indica*,' 1855, but the experience gained in producing the single volume issued showed him that a work conceived on that scale was hopeless of preservation. '*The Flora of British India*,' therefore, was planned on a more modest scale, and with other Indian botanists to help by undertaking assigned portions. The soundness of this procedure was proved by the finishing of this enumeration in seven octavo volumes, 1872-1897, an event marked by the striking and presentation of a gold medal by the *Linnean Society* in 1898.

The '*Genera Plantarum*,' 1862-83, which was worked up chiefly from material at Kew, in conjunction with George Bentham, was a monumental production, in which both of those distinguished phytogeographers contributed their type experience; it differed from its predecessors by being based upon actual examination of authenticated specimens or actual types, and was not merely literary compilation. The last big work on which Hooker started to engage was that termed '*Index Kewensis*,' which occupied thirteen years and a half from first to last. It was due to Charles Darwin, who induced Sir Joseph Hooker to get the work undertaken; he approved the plan submitted by the actual compiler, and acted as the channel by which the needful funds were received from Mrs. Darwin. As the work progressed and became available for

reference, Hooker's interest in it increased, and finally he went through the MS. to revise the geographical notes and read the proofs. Unluckily Mr. Darwin himself died within three months of the undertaking being put in hand.

With this activity in botanical publication, Hooker's influence in other directions must not be overlooked. He was Darwin's confidant for fifteen years before evolution was brought before the scientific world in July 1858. He spent five years as President of the Royal Society, 1873-78, with its consequent numerous committees, and served on the Council of the Linnean Society almost uninterruptedly from 1846 to 1884, and was Vice-President from 1861 to 1876 and 1882 to 1884, though he declined the Presidency in 1886, after his retirement from Kew.

Such is a rapid outline of Hooker's life, which is treated in detail in the two volumes before us. Mr. Leonard Huxley is well qualified as the biographer, being the eldest son of Prof. T. H. Huxley, F.R.S., Hooker's intimate friend, and, although it is not declared, is the god-son mentioned on page 59 of the second volume. With the material already arranged by Lady Hooker, the connecting text became manageable, otherwise the bulk available might have proved insuperable.

Many portraits are extant, in various media; that reproduced as the frontispiece to the first volume is, perhaps, the least satisfactory, Hooker himself pronouncing it "lackadaisical," the very word the present writer had always applied to it.

In so long a work it is not surprising that slips occur—some due to the printer, but not all. Here are a few, which should be corrected in a second issue. The "S. J. Klotzsch" mentioned in the note in vol. i. p. 25 was Johann Friedrich Klotzsch (1805-60). The name "*Osmanthus*" on page 367 of the same volume must be meant for "*Osmothamnus*." What was the date of the letter cited? It must have been after 1882, when *Rhododendron anthopajon* was printed in the 'Flora of British India,' with *Osmothamnus fragrans* and *O. pallidus* as synonyms.

In the second volume, on page 247, line 23, the name should read Maingay, and p. 447, *Mongotii* and *Munim*; while such slips as "splendid" and "Penguins" are simple press errors.

There are two Cunninghams curiously confused in the Index, ii. p. 527; in vol. ii. David Douglas Cunningham (1843-1914) is referred to on p. 427, note, but his brother Robert Oliver Cunningham (1841-1918) on p. 80, and 101, note.

We close the volumes, which have recalled the memory of many vanished botanists, with gratitude to the writers whose labours have done so much to place on permanent record the great and strong personality which Hooker's surviving contemporaries must always remember with pleasure. It was indeed their good fortune to have been associated with so commanding a figure. B. D. J.

FIG. 1.

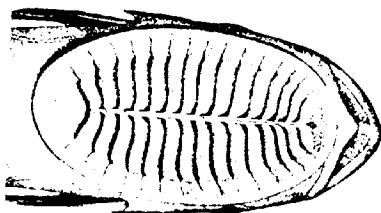


FIG. 2.



FIG. 3.

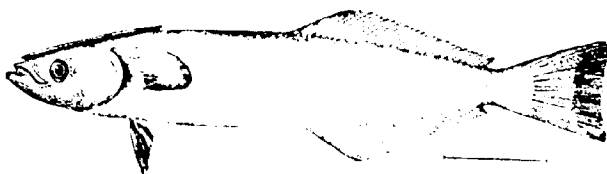


FIG. 4.

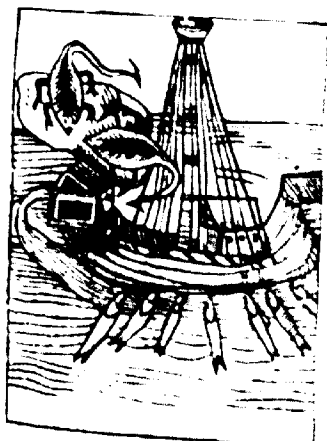




Fig. 5.

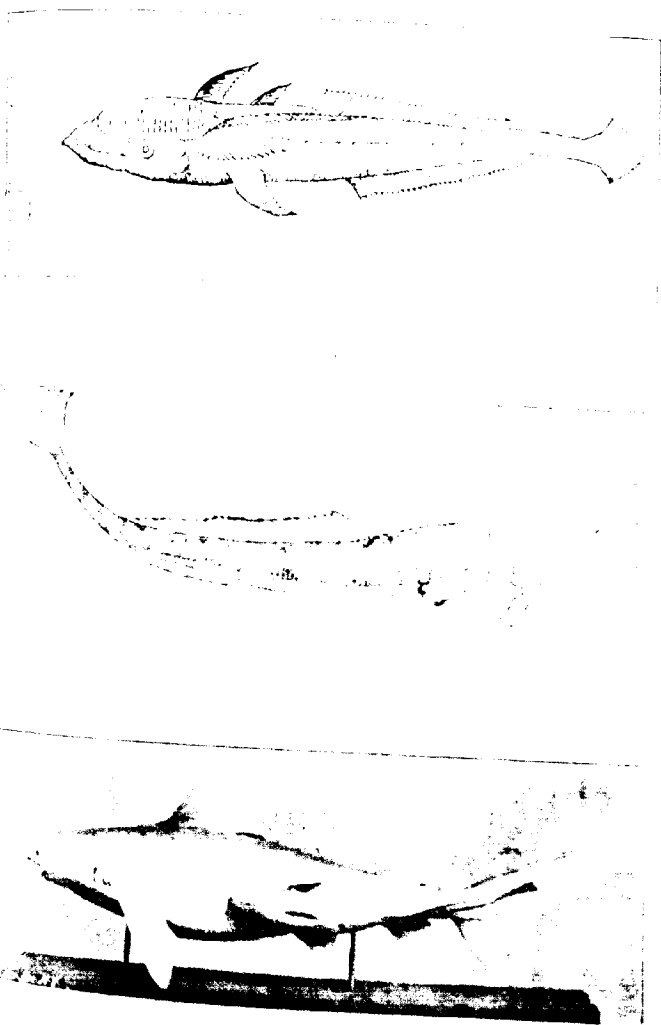
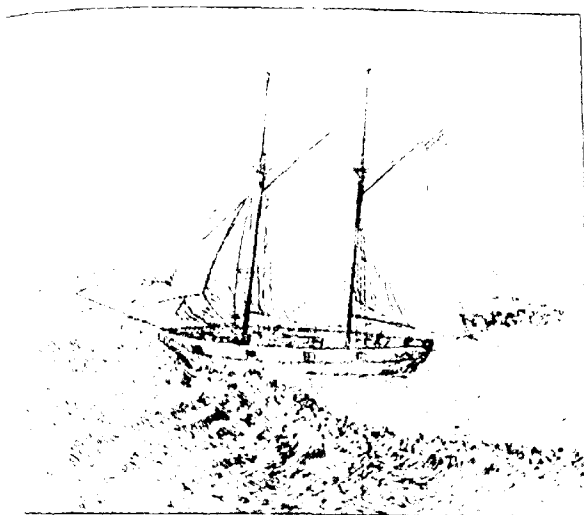




FIG. 5.

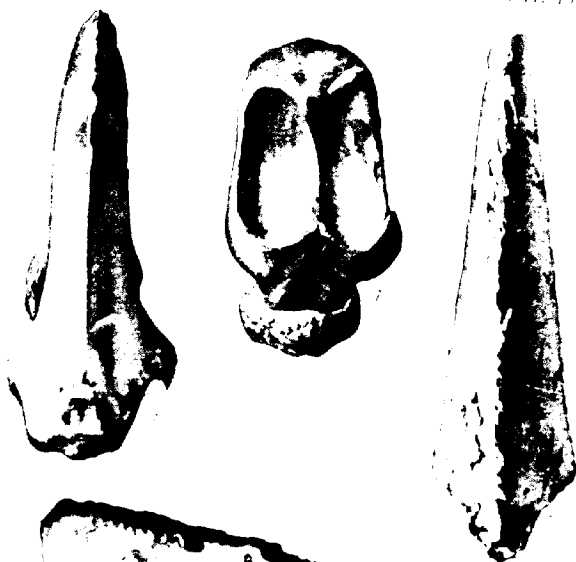














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